THURSDAY, SEPTEMBER 13, 1894.

BACTERIA IN WATER.

Micro-Organisms in Water; their Significance, Identification, and Removal. By Prof. Percy Frankland and Mrs. Percy Frankland. (London: Longmans, Green, and Co., 1894)

ON perusing this volume, there can be left no doubt in the mind of anyone who has paid attention to the enormous progress in the knowledge of micro-organisms in water, that the authors have succeeded in producing a work which testifies to a full and accurate survey of the subject, and to a large amount of original observations carried out by the modern approved methods. For these reasons we venture to say that this volume will occupy the position of a valuable text-book and standard work on the subject of micro-organisms in water. The views which the authors, in common with modern sanitarians, hold as to the relative value of the chemical and biological examination of potable waters, deserves special attention on behalf of some distinguished chemists, on whose mind the whole progress of bacteriological science seems to have as yet made but little impression; in this connection we quote, from p. 117, chapter v., the authors' statement which, being those of a distinguished chemist, it is to be hoped will have the desired effect:—"If water which is known to have received sewage matters (and the *entire* exclusion of such from supplies drawn from rivers is practically impossible) is to be supplied for dietetic use, and if this water, as is so often the case, is not objectionable on account of the absolute quantity of organic matter, as revealed by chemical analysis, which it contains, but only of the suspicious origin of a part of this organic matter, then it is evident that in the purification of such water the point to be taken primarily into consideration is how the organic life it contains can be reduced to a minimum." The authors might have further added that the chemical analysis only of such waters is for sanitary purposes of little practical use, since a water may contain less than the recognised amount of organic matter, and yet be dangerous for drinking purposes on account of the presence in it of some undesired pathogenic microbes. The amount of organic matter and the presence of these latter in water need not, and in some cases (*e.g.* the well-known outbreak of typhoid fever at Caterham) do not bear a constant or a definite relation to one another. As a more recent illustration of this kind, the well-known instance of the cholera in Hamburg and Altona in 1892 may be quoted.

As is well known, Hamburg and Altona (p. 152) "are dependent upon the river Elbe for their water supply, but whereas in the case of Hamburg the intake is situated *above* the city, the supply for Altona is abstracted below Hamburg after it has received the sewage of a population of close upon 800,000 persons. The Hamburg water was therefore, to start with, relatively pure when compared with that destined for the use of Altona. But what was the fate of these two towns as regards cholera? Situated side by side, absolutely contiguous in fact, with nothing in their surroundings or in the nature of their population to especially distinguish them, in the one (Hamburg) cholera swept away thousands, whilst in the other (Altona) the scourge was scarcely felt." . . . "The Hamburg water, to start with, was relatively pure when compared with the foul liquid abstracted from the Elbe by Altona; but whereas in the one case the water was submitted to careful filtration through sand before delivery, in Hamburg the Elbe was distributed in its raw condition as taken from the river." Here we have water coming originally from the same source, which was yet widely different in biological respects for the two sets of consumers:—

(*a*) Hamburg water, chemically comparatively pure.

(*b*) Altona water, chemically foul, owing to great sewage pollution; yet the Hamburg water proved deadly because rich in cholera germs, while the Altona water, from which most of these germs had been removed by careful filtration, but chemically still impure, did little harm.

Prof. Percy Frankland, when before the Royal Commission on Metropolitan Water Supply, seemed to have resented a statement made by myself before that Commission as to the comparatively small value that sanitarians attribute to a purely chemical analysis of water; inasmuch as he (Prof. Frankland) quoted the very water of Hamburg as proving the importance of chemical analysis. He said that the Hamburg water which he had examined for the editor of the *British Medical Journal*, would already, on chemical grounds, have been condemned as unwholesome water. But he was immediately after this answer confronted with the information not then known to him (Prof. Frankland), given to him by one of the Commissioners, viz. that the population of Altona drank with comparative immunity the same water, only chemically more polluted, the difference between the two waters being that the Hamburg water was consumed unfiltered, while the Altona water was filtered before delivery. From what we have quoted above, it is satisfactory to find that Prof. P. Frankland, in common with others, does not attribute great value to chemical analysis alone.

The subject of preparation of culture media for bacterioscopic water-analysis, and of the methods of isolation of micro-organisms from water, are treated in a fairly exhaustive manner in chapter i. We miss, however, the description of the methods of making agar plates, probably because the authors as a rule used only gelatine plates. Chapter ii. gives a detailed description of the methods of staining bacteria. It is not quite clear where, in the examination of micro-organisms in water, the staining of sections of tubercle, leprous, and other pathological tissues comes in; at any rate, if quoted, it might as well have been quoted more perfectly. Chapter iii. deals with the examination of water for micro-organisms; chapter iv. with the bacterial contents of various waters, of rivers, lakes, wells, springs, sea-water, ice, hail, rain, &c.; chapter v. with the purification of water for drinking purposes by the various filters in use on large and small scales, sterilisation by heat, subsidence, chemical treatment, &c.; and chapter vi. on the multiplication of the micro-organisms in water. All these subjects are treated in great detail, both on account of the large amount of bibliography, as also on accoun of a considerable amount of work contributed by the authors

themselves. There are, however, two subjects on which it is necessary to make some comment. The first refers to a passage on p. 119; they say: "In the year 1885 Koch's gelatine process of water examination was first introduced into this country by one of us."

I am quite sure that Prof. P. Frankland hereby quite unintentionally omitted to state the fact that Dr. Angus Smith (*The Sanitary Record*, 1883) was the first to apply the gelatine test for showing the relative number and the different characters of the colonies of the microbes present in water.

The second point refers to the factors which determine the efficient character of sand filters. From p. 119 to p. 142 we have a detailed account, with numerous tables, of the results of the bacteriological examination of London waters "by one of us," yet no mention is made and no indication is given of one of the most important factors (*cæteris paribus*) in efficient sand filtration, viz. the formation in the superficial layers of the filter bed of a slime (Schlamm); it is precisely after the formation of this "slime" that the filter becomes efficient, it is inefficient before the "slime" is formed. The authors have had abundant indications as to the importance of this "slime"; they quote on p. 158 researches by Piefke, who demonstrated already in 1887 that (p. 159) "it is the slime deposit on the sand which constitutes the real filtering material in the water-works' filter." Further indication of the importance of this "slime" was given to the authors by Prof. Lankester's extremely valuable evidence before the Royal Commission on Metropolitan Water Supply, November 1892, and lastly by Koch's paper on water filtration in the *Zeitschr. f. Hygiene und Infektions*, vol. xiv. Koch clearly shows that the sooner this slime is formed—water which initially contains a greater amount of impurity would form it sooner than water initially pure—the sooner the filtration becomes efficient; further, that on renewal (by scraping) of the surface of the filter this protective slime is removed, and therefore the filter for the time becomes inefficient; then the influence of frost on this slimy layer, and a variety of other important points connected with this slime. All these and others are of the utmost importance as regards the real understanding of the working of sand filters; *e.g.* the exact nature of the slime, the conditions affecting its formation, the differences of its formation in the filter-beds of the various London Water Companies, and at various periods, &c. All these points require elucidation, and one must regret that the authors have missed a valuable opportunity to treat of these in the book; since the researches "by one of us" made of the London waters in 1886, which are quoted in full in the work, no real progress appears to have been made. One thing, however, is brought out by the observations not only of Fraenkel and of Piefke, but of all that have worked on the question of purification of drinking-water by filtration, and that is (p. 157) that "even under the most favourable conditions of working the sand filters do not form a complete obstacle to the passage of micro-organisms."

Chapter vii., on the detection of pathogenic bacteria in water, gives an extensive bibliography and the most reliable methods for the detection of bacteria, the typhoid bacilli, and Koch's comma bacillus receiving a not undeservedly large share of attention. With regard to the differentiation of bacillus coli and typhoid bacillus by the presence or absence of gas-bubbles in gelatine cultures, the authors state (p. 269): "This distinction has been shown by one of us to be available in an extremely simple form for the differentiation of the two organisms," viz. the bacillus coli forming gas-bubbles in gelatine shake cultures already after twenty-four hours' incubation at ordinary temperature, while the bacillus of typhoid does not do so. I am able to confirm this, and to state that this characteristic formation of gas-bubbles by bacillus coli in gelatine shake cultures has been known and practised in my laboratory for more than two years, and is described by me in the Reports of the Medical Officer for the Local Government Board, 1892–1893; also in the *Journal of Pathology and Bacteriology* November 1893; and in the *Centralblatt für Backt. und Parasit.* vol. xv. Nos. 8 and 9.

There is one further subject to be mentioned, viz. on p. 272 and p. 273. The authors in using Parietti's method, in order to detect the typhoid bacillus in water, recommend adding to the cultivating medium "1 to 10 drops of the water under investigation"; if, as is almost invariably the case, the typhoid bacillus is present in the water in a highly diluted state, *i.e.* few examples in a large bulk of water, how the authors can under these conditions hope to recover the typhoid bacillus by using 1 to 10 drops of the water, is difficult to see. True, later on, on p. 285, an important addition *in small print* is made in the shape of a note at the end of chapter vii., to the effect that in "examining water for the typhoid bacillus it is advisable to pass a considerable volume, 250 c.c. or upwards" (this sounds rather different from 1 to 10 drops) "through a sterile porcelain or infusorial earth filter, and then to transfer this deposit on the surface of the cylinder by means of a sterile brush into a small quantity of sterile water"; this is then used for cultivation. This is the identical method which was used by me with success in the summer of 1893 in detecting the typhoid bacillus in the Worthing water, and soon after in the water from a polluted well in Rotherham.[1]

For the means by which Koch's cholera vibrio can be differentiated from other vibrios that have been hitherto found in water, the authors (on p. 279) mention Koch's conclusion that the absence of indol reaction, as well as the absence of any pathogenic effects on guinea-pigs, sufficiently distinguish the non-cholera vibrio from Koch's comma bacillus. This conclusion is definitely contradicted by a number of more recent observations made by independent workers, amongst them notably R. Pfeiffer (*Archiv. f. Hyg. und Infekt.* vol. xvii.).

Chapter viii. treats of the vitality of particular pathogenic bacteria in different waters; a large amount of bibliography with tabulated results by the various authors are given *in extenso*. Turning to the vitality of the typhoid bacillus, we find one observer (p. 290), Braem, gives the vitality of this bacillus in distilled water 188

[1] A similar remark may be made to a passage on p. 283. The authors in describing the detection of anthrax spores in water, state:—"A method has been devised by one of us (1893) suitable for the detection of anthrax spores when present along with other micro-organisms in water." This consists in killing by heat the non-spore-bearing forms, while the spores, being more resisting, survive. This method "one of us" might have found described in Klein's "Micro-organism and Disease," 3rd edition, 1886, p. 106.

days; Hochstetter, on the other hand, not exceeding five days; Meade Boulton, from two to three and ten to fourteen days; Wolffhügel and Riedel, thirty-two days. Similarly as regards the vitality of Koch's cholera vibrio in distilled water, Percy Frankland states that none were discoverable on the second day (the vibrio was initially in a weakened condition); Hochstetter, twenty-four hours to seven days; Nicati and Rietch, more than twenty days; Slater, five hours; Strauss and Dubarry, fourteen days. These differences are extremely perplexing and materially interfere with the value of the statements. As all these observers used distilled water, the differences as to the vitality must be due to the microbes themselves; the readiest explanation is this, that the different observers used the microbes in different states of resistance. It is perfectly well known that a variety of conditions, such as the nature of the nutritive medium in which the organisms had been growing, the age and the pedigree of the culture used, determine the resistance and vitality; unless, therefore, in all cases the best and most favourable cultures are used, the observations are of small value, and the authors justly [(see pp. 331 and 334) lay stress on similar points.

One conclusion proceeds with clearness from the recorded observations, viz. that (p. 261) "a number of bacteria, possessing pathogenic properties of the most pronounced character, have been detected in natural waters from time to time," and it is therefore not quite correct to assume, as is generally done, that typhoid and cholera are the only diseases whose germs are distributed by water, nor is it justifiable to limit our attention to these two species only, because the whole subject of the identification of specific bacteria in water is practically still in its initial phase.

Chapter ix. and last, on the action of light on micro-organisms, is extremely well written and gives a detailed account of this important and ever-widening field of research; the history of the whole subject and the very valuable results obtained by the authors (or rather "by one of us"[1]) are described in a thorough and readable manner. It is to be regretted that the beautiful and well-known researches of Prof. Marshall Ward on the fundamental difference of action of the red and blue part of the spectrum should have been passed over.

In an appendix a valuable and up-to-date systematic description is given of the micro-organisms that have been hitherto found in water, by which their identification is greatly facilitated. We only wish the authors had not ventured to classify them into pathogenic and non-pathogenic bacteria, the former indicated by being printed in red letters, the latter in black. The authors do not accurately define, for obvious reasons, what is and what is not a pathogenic micro-organism, but give a list of "those microbes which have been found to be pathogenic to man or animals." The classification in the appendix is both incorrect and misleading. It is incorrect because a great many of the microbes mentioned here as non-pathogenic, produce disease and death in the guinea-pig if injected in sufficiently large doses into the peritoneal cavity; it is misleading because microbes are mentioned here as pathogenic, *e.g.* the *Bacillus coli*, the *Proteus vulgaris*, the *Proteus mirabilis*, which have no greater claim to such a designation than the *Bacillus prodigiosus* or the *Bacillus subtilis;* for it has been conclusively established, by a number of independent observers, that these latter act in the same way pathogenetically when injected into the guinea-pig's peritoneum as the *Bacillus coli*, the vibrio of Koch, or the bacillus of typhoid fever.

In conclusion, we have no hesitation in saying that, short of the omissions that we have pointed out, the book will take a prominent place amongst the standard works on micro-organisms in water. E. KLEIN.

[1] This expression occurs over thirty times.

RITTER'S "ASIA," RUSSIAN ADDENDA.

East Siberia. Part i., *being the Sayan Highlands in the Government of Irkutsk, in the South of the great Siberian Highway, up to the South-western Extremity of Lake Baikal.* By P. P. Semenoff, I. D. Chersky, and G. G. von Petz. (St. Petersburg, 1894.)

THIS volume belongs to the great undertaking of the Russian Geographical Society, which was begun many years ago with the intention of publishing addenda to those parts of Ritter's "Asia" which deal with regions of the great continent belonging to Russia, or touching its frontiers. The large number of geographical researches which have been made since the year 1832, when Ritter's great work had been published, and the difficulty of treating them with the same details as Ritter had treated the scanty information available sixty years ago, have resulted in many delays in the appearance of the promised volumes, and even this last one comes out as the work of three different persons—P. P. Semenoff taking it up when Chersky had met with an untimely death in the far north of Siberia. But in the hands of P. P. Semenoff, the volume we now have before us bears no traces of an incomplete posthumous publication. On the contrary, it is a well-finished work, worthy to take one of the first places among the several excellent volumes of "Russian Addenda" previously published.

Not only the great lines of Ritter's classical work and its spirit could be fully maintained, but the many explorations which have been made in this region during the last sixty years, have only confirmed the correctness of the conceptions of the great geographer. The Sayan mountains appear, indeed, as a huge border-wall of the great massive upheaval of North-west Mongolia, and as a part of the immense border-ridges which fringe the high plateau of East Central Asia. And in the Alpine regions beyond it there is no trace of the chains which Humboldt wanted to run along the parallels, and the meridians. There is, in the Tunka, the Kitoi, and the Byelaya Alps, simply a succession of chains running roughly parallel to the border-ridge.

In the huge border-ridge lies the 11,500 feet high Munku Sardyk, the highest mountain of East Siberia, which till lately was supposed to be the only one snow-clad peak in that part of Asia. Its glaciers and its summit had already been visited and described by Radde in 1856, but the present volume contains also the most interesting observations of Captain Bobyr, who has revisited the peak, and from whom we learn that four more peaks rise above the snow-line in the same part of the

Sayans. One of them, situated further west and named Peak Middendorff, gives origin to mighty glaciers, visited by M. Yachevsky. The same expedition has fully confirmed the fact which was much contested five-and-twenty years ago, namely, that the highlands lying in the south of the Sayans are a plateau, 3000 to 4000 feet high, belonging to the great plateau of East Asia.

However, much remains to be done to explore the border-wall of this plateau, for, apart from the exploration of the Munku Sardyk and the plateau in the south of it, by Captain Bobyr, little has been added to what was known thirty years ago from the rapid excursions of Radde, Polyakoff, and the writer of these lines. The ridge offers, however, a good deal of interest in more than one aspect. It gave rise, probably, in the early Quatenary period, to mighty flows of lava, which spread down the valleys of its northern slope, reaching the valley of the Irkut; and, in the valley of one of the tributaries of the Upper Oka, the Junbulak, two small craters of ejection, 400 feet high, were described in 1864. Unhappily, these formations, so interesting in the very heart of Asia, at an altitude of about 6200 feet, have not been revisited since, and all we know about them is what could be gathered during a rapid excursion.

The beautiful valley of the Irkut, between the Sayans in the south, and the wild stony wall of the Tunka Alps in the north, is described next, and a masterly perusal of the available documents gives a very lively picture of that broad valley, covered with lacustrine deposits, and, about the Tunka village, with sheets of lava. But with the mountains in the north of this valley one enters again in a field nearly quite unbroken by the explorer. Happily enough, Chersky has crossed it in at least one direction, and some of the most interesting parts of the present volume are those given to the description of these mountains, among which the Munku Sagan Khardyk—snow-clad, as its very name shows—reaches to the unsuspected height of nearly 10,000 feet. The description is the more interesting, as it is based upon Chersky's unpublished MS. notes, and it is sufficiently detailed to give a good idea of that part of the immense Alpine region stretching in the north of the Irkut. Further west, the footpath which leads to the long since abandoned graphite mines of Mount Alibert, and which has been followed by several geographers, as also further east, this grand mountain region, rising to 7000 and up to 9000 feet above the sea-level, continues to remain totally unknown. Even the river valleys of the Kitoi and the Byelaya are only mapped in their lower courses.

The 1500 to 2000 feet high plains which lie in the north of this Alpine region, and which will soon be intersected by the great Siberian railway, come next. These fertile plains are well explored by this time, and their climate, soil, and flora are fully described; especially the flora, for which we have the excellent works of MM. Agapitoff, Prein, and J. Freyn (plants gathered by Ferd. Karo), so that we not only possess lists of plants, but know their distribution and subdivision into vegetable "formations," the whole making a capital addition to the classical work of Turchaninoff.

And, finally, the volume contains a full geographical and statistical description of the regions occupied by both the Russian and the Buryate settlements on the high plains along and on both sides of the present Siberian highway.

In the appendix the description of the Nizhneudinsk caves, explored by Chersky, is especially interesting for the naturalist; the more so as Chersky's report had only been published in Russian, in the little-known publications of the East Siberian Geographical Society, and his collection of bones was destroyed during the great Irkutsk conflagration. These caves, situated in limestones 700 feet above the level of the Uda River, and attaining a total length of 1525 feet, contain immense quantities of relics of all sorts of mammals, 17 feet thick at certain places. Moreover, in consequence of the low temperature which prevails in the caves, the bones of the animals are sometimes found with perfectly well-preserved pieces of cartilages, muscles, and skin attached to them. The species discovered by Chersky were:—*Vespertilio borealis* and another still living species of bat; *Sorex vulgaris*; *Canis Nischneudinensis*, a species of wild dog, analogous to, but separate from, the *Canis alpinus*, which may still exist in the mountains of the above Alpine region; the Arctic fox (*Canis lagopus*) and the common fox (*C. vulpes*); the common bear, the *Gulo borealis*, and the sable; a species of *Spermophilus*, different from both the *S. Eversmanii* and the *S. Perryi* which exist in north-east Siberia (its samples have perished during the Irkutsk conflagration); several *Arvicolæ*; the lemming, probably *Myodes obensis*, various soft parts of the head and fore-feet being well preserved with the bones; *Lepus variabilis*, *Lagomys hyperboreus*, *Cervus tarandus*, and *Antilope saiga* (named *Antilope borealis* by Chersky); an undetermined species of *Capra*, the horse, and, what was most striking, a piece of the skin of a rhinoceros. This find was so extraordinary that Chersky hesitated to consider it as a rhinoceros skin, and mentioned it in his report as *Sus?* And so it appears also in Count Uvaroff's "Anthropology." But this piece had happily been sent to St. Petersburg before the conflagration took place, and on nearer examination it at once was recognised as having belonged to a rhinoceros, on account of its characteristic oval pits filled with clusters of seven to ten, and even thirty-three hairs in each cluster. The mixed fauna of the caves proves that they have been filled with animal remains since the Glacial period, and possibly it also points out (through the *Saiga* remains) to a relatively warm post-Glacial period. It is evident, at any rate, that a new exploration of the Nizhneudinsk caves would prove of great utility for post-Glacial palæontology.

The foregoing rapid sketch gives an idea of the interesting contents of this volume. The very name of P. P. Semenoff is itself a guarantee for a thoroughly scientific and good all-round use having been made of all the available materials, without falling into the lengths and repetitions which one would readily excuse in a work of this kind, if they existed. The whole is a lively description of the region, with a view to the grand lines of structure, combined with minutest accuracy in even small details. It would certainly be a great regret if this volume, like the preceding ones of the Russian addenda to Ritter's "Asia" (Amur, East Turkestan, West Sayans) were to remain accessible to Russian geographers only.

P. K.

ELEMENTS OF COMETARY ORBITS.

Verzeichniss der Elemente der bisher berechneten Cometenbahnen. By Prof. Dr. J. G. Galle. (Leipzig: Wilhelm Engelmann, 1894.)

THE volume which we have before us contains, as its title indicates, a list of the orbits of all those comets which have up to the present time been calculated. As our readers may already be aware, this is not the first "Verzeichniss" with which Prof. Galle has presented us, for one has only to refer to the second edition of "Olber's Methode zür Berechnung der Cometenbahnen," by Encke, where will be found a collection of the orbits of comets which had appeared up to the year 1847. In the following or third edition, which came out in 1864, the list was expanded, revised, and brought up to date. The present "Verzeichniss" has, however, assumed larger proportions than its predecessors, containing as it does over 300 pages, and so is published as a separate work.

In the introduction the author sums up in a few words the chief points about the numerous lists of cometary orbits which have been published from time to time, referring chiefly to the different ways in which they have been arranged and compiled.

Several changes from preceding lists have been adopted in the book before us, and we will chiefly restrict ourselves to a brief statement of the same. It may be mentioned here that the order of the elements of the same comet has been so chosen that the less accurate elements precede those which have been considered more correct, so that the last elements in every case are those which approach nearest to the truth.

Two important alterations concern the removal of the distinction between direct and retrograde moving comets, and the way of representing the inclinations of orbits from 0° to 180°. Instead of the Longitude of Perihelion (π) being adopted, Prof. Galle employs the angle between the node and the perihelion point, that is, he introduces an angle ω, which equals the Longitude of Perihelion minus the node, so the relation may be represented by $\omega = \pi - \Omega$. The arc ω has been termed the "Argument of Perihelion," and is somewhat analogous to the "Argument of Latitude" ($u = v + \pi - \Omega$), so that ω is the Argument of Latitude for $v = 0$, or is Perihelion point.

To pass from the "Argument of Perihelion" ω, to the "Longitude of Perihelion" π, without distinguishing between direct and retrograde movement, the simple relation $\pi = \Omega + \omega$ is used. On the other hand, if, after the old style in the case of retrograde moving comets, the Longitude of Perihelion is denoted by the difference $\Omega - \omega$ and represents this by π', and if also i' denotes the value of the inclination in this case only as far as 90°, then the relation for the reduction is as follows:

$$\pi + \pi' = 2\Omega. \quad i + i' = 180°.$$

Following the columns dealing with the position of Perihelion, the Node, and the Inclination, are others giving the logarithms of the Perihelion distance, and the eccentricity, concluding with the names of the computers of each of the orbits and the references in every case.

In addition to the above, we have no less than 160 pages of remarks and literature references, which will be found invaluable by those searching for special information about any particular comet. Perhaps a brief note will best serve to give the reader some idea of the style in which the author has brought together the information. The subjoined note, picked out at random, is typical of the method followed.

No. 356. 1883 II. Discovered 1884. January 7, by Ross in Elsternwick, at Melbourne, observed only for a few days in the southern hemisphere and in Madras, by Ellery in Melbourne until February 4, still approaching February 7 and February 19. At first visible with the naked eye, then afterwards dimmed quickly and difficult to observe—*A.N.* cviii., cix. *M.N.* xliv., xlv. *Observatory* vii. NATURE xxix.—*Tebbutt's* elements are computed from the observations made on January 19, 23, 28. *Tennant's* from those of January 17, 26, 30. *Bryant's* from three normal positions January 19, 25, February 2. *Ellery's* from those of January 12, 18, 28. Oppenheim's from those of January 12, 18, 28, 29, February 4. Three computed ellipses, one by Tennant and the other two by Bryant, in *M.N.* xlv. and xlvii., have been omitted, so also an approximate orbit by Hind in NATURE xxix.—All the above-mentioned orbits are referred to the M.E. 1884, 0.

As a rule the notes are much longer than the above, some, such as those which relate to comets 1880 I., 1881 III., 1882 I., 1882 II., 1889 V., &c., extending over a page or more.

In the compilation of this work, the thoroughness with which it has been done is a striking feature throughout, and Prof. Galle deserves the thanks of all astronomers for the completion of this volume. The information is brought up to the beginning of this year, thus making the book, besides the best, the most recent of all other lists.

W. J. L.

OUR BOOK SHELF.

Primary Geography. By A. E. Frye. Pp. 128. (Boston U.S.A.: Ginn and Co., 1894.)

WE have never seen a class-book of geography more profusely and admirably illustrated than the one under review. Our only regret is that the book, being written for schools in the United States, possesses the eccentric or reformed orthography that obtains there. This, in conjunction with the fact that the British Isles are dismissed in less than a page of text, renders the volume unsuitable for use in our schools. We hasten to remark, however, that the author has not merely concerned himself with the interests of the United States, as a brief statement of the various sections in his work will show.

The book opens with what is called "Home Geography," which section deals with elementary facts of physical geography observable at any place. The earth is next studied from an astronomical point of view; and then follow descriptions of the slopes of the earth. After describing the surface features of the different continents, the author passes to an account of the peoples of the earth, and then to meteorological phenomena. This is followed by sections on plants and animals, and finally commercial geography is treated, the continents being taken in succession. The book has so many excellent points that we can only mention a few of them. One is that the text on people refers to child-life, and must therefore appeal to children more than references to cheek-bones and the texture of hair. Plants and animals are studied in their relations to climate and physical features, and thus a clear idea as to the causes affecting

distribution is obtained. Another good point is that each of the great divisions of the earth's surface is shown in its relation to the whole; in other words, the earth is the unit throughout the book. But it is in the matter of illustrations that the work excels all others of its kind. The hundreds of pictures and maps are really works of art, and the author does not claim too much when he expresses the thought that they are superior to those in any similar school book. They are true to nature, most of them having been engraved from photographs; they well illustrate and supplement the text, and they present typical forms. Only in two or three cases can any fault be found. In some of the relief maps showing hemispheres of the earth, the parts of continents extending beyond the hemispheres are, as it were, lifted from the other side, and drawn in outside the containing circle. We are sure that this will lead to misconception, for children will get the idea that the continents are surfaces lying on the earth instead of portions of the earth itself above sea-level. But this is a small matter, and one easily remedied. The book is both attractive and instructive; it reflects great credit upon the author for his originality, and upon the publishers for their enterprise. We should be glad to see a similar work produced on this side of the Atlantic.

Theoretical Mechanics. Vol. i., *Solids.* Vol. ii., *Fluids.* By J. Edward Taylor, M.A., B.Sc. (London: Longmans, Green, and Co., 1894.)

WHEN Solomon delivered himself of the sage remark that "there is no new thing under the sun," his prophetic eye may have been looking up the corridors of time, and seen the "soul-destroying text-books" (as Dr. Armstrong terms examinational literature) of the present day. It is only rarely that a text-book writer goes beyond his brief. He designs his book to meet the requirements of a particular examination, and feels that he has performed his task successfully if future questions set by the examiners are more or less anticipated in the text. Such a writer has little scope for originality. If he departs much from the lines laid down in the examiners' syllabuses, his production fails in its object, and if he keeps the contents within the examiners' bounds, he incurs the censure of the reviewer. Thus it is that text-books are often mere summaries, and that there is a family likeness between those covering the same ground.

The volumes which Mr. Taylor has put together cannot, by the greatest stretch of imagination, be termed interesting. They are little more than collections of exercises and examples. We do not, however, raise any objection to this. Theoretical mechanics, like arithmetic, can only be learned by steadily working at exercises, and of these there is an abundance. The examples are also numerous, and they are so clear that the most obtuse student cannot fail to understand them. There is nothing remarkable about the illustrations except their familiarity. Most of them are very old, and many have done duty time after time.

The Animal as a Machine and a Prime Motor, and the Laws of Energetics. By R. H. Thurston. Pp. 97. (New York: John Wiley and Sons. London: Kegan Paul and Co., 1894.)

PROF. THURSTON, the head of Sibley College, Cornell University, ranks very high among American engineers. He is well known as the author of several widely-used text-books and of numerous important papers on engineering matters. The volume just published runs into less than one hundred pages; but in that space, energy and its transformations, and the relations between matter, force, and energy are skilfully described. The chapter which deals with the animal as a prime motor will be found attractive from many points of view, and should be read by all who have to do with the muscular work of men and animals. Among the many matters with which it is concerned are the processes of vital machines, the efficiency of the animal system, effective methods of application of power, intensity of muscular effort, dietaries, and the draught of vehicles. To a large extent the book is made up of reprints from magazines, and selections from various works; nevertheless, it contains many original and valuable points, and will add to the author's already high reputation.

The Aborigines of Western Australia. By Albert F. Calvert. Pp. 55. (London: Simpkin, Marshall, Hamilton, Kent, and Co., 1894.)

CAPTAIN WILLIAM DAMPIER, the first Englishman known to have made the acquaintance of the Australian natives, referred to them as "The poor winking people of New Holland . . . the miserablest people in the world." Mr. Calvert, who has had a little experience with the natives, looks upon their imperfections with a more lenient eye than the plain-spoken buccaneer, who visited Western Australia in 1688. He gives descriptions of a few of their habits and rites, the information being drawn in some cases from journals in the British Museum, while in others it is based upon his own recollections. Their marriage laws are curious. Children of either sex always take their mother's family name, but a man may not marry a woman of his own family name. Interesting descriptions are given of aboriginal funeral ceremonies, and these, with one or two other matters of interest to anthropologists, render the book worth reading, if a little discretion is used.

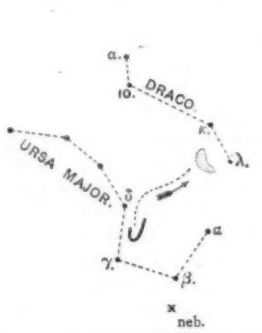
LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Remarkable Meteor.

THE course of the meteor of August 26 can only be ascertained by comparing observations from different points of view. If the meteor fell near Gloucester, other observers to the north, east, or west of that city will have seen it in a part of the heavens far removed from Draco and Ursa Major.

I was at Wimborne (about 75 miles south of Gloucester) on the 26th ult., and, as I was gazing up to the zenith at the time



This figure accompanied Mr. Earle's letter last week. To it a x has been added to show the position of nebulous remains of meteor as seen from Wimborne.

the meteor fell, I missed its descent, but attracted by the vivid glow, I was just in time to catch sight of a brilliant light, which seemed to me two or three times as bright as Venus at its brightest. Any elongated trail disappeared quickly, but a

nebular light remained at the lowest point reached by the meteor, which assumed a vague oval shape and imperceptibly faded away. For four minutes the nebular light was easily watched; then I ceased to note the time, and after two or three minutes more I failed to distinguish it.

The position of the nebulous remains of the meteor appeared to me vertically beneath β Ursæ Majoris, at a distance from it rather more than one-third the distance of α from β. I did not notice any motion, but if the apparent upward movement of the nebulous light were due to a north-north-west current of air drifting the light incandescent ash of the meteor to the south-south-west, the motion would be imperceptible to a distant observer who was nearly in the same line up or down the direction of the wind. EDWARD F. LINTON.

Bournemouth, September 8.

IN case it may prove of interest, I write to say that I noticed the meteor mentioned in your last number by Mr. John Earle, as having been seen on the night of August 26. I was walking in the country that evening, and not long after 10 p.m. I saw the landscape lighted up as by a vivid flash of lightning from behind me—my back being towards the north at the time. On turning round, I just caught sight of the meteor as it disappeared, leaving a bright track behind it, about two degrees of arc in length. This track, as seen from where I stood, lay half-way, or nearly so, between the last star in the tail of Ursa Major and Alpha Canum Venaticorum, and in a line connecting the above two stars. It lasted several minutes, as far as I could judge, gradually fading away, and curled up at the lower end, after the manner described by Mr. Earle; but I did not detect any change of position. It seemed to remain about half-way between the end of the tail of Ursa Major and Alpha Canum Venaticorum all the time it was visible to me. I regret that, not having matches with me, I was unable to read my watch and take the exact time of the phenomenon. T. B CARTWRIGHT.

Brackley House, Brackley, September 7,

THE meteor of August 26, referred to by Mr. Earle, was seen at Northwich by me, and noted as remarkable owing to the long continuance of the brilliant light in the sky. We had had thunder and lightning in the afternoon, but the clouds had cleared away, and the stars were visible through a faint haze. On entering my garden shortly after 10 p.m., I saw a most brilliant flash of what I took to be lightning. Not hearing any thunder, I looked to see from whence the flash had proceeded. I then saw, almost in the zenith, but a little to the west, a brilliant streak of light. This remained nearly stationary for perhaps half a minute, and then one end bent till the light assumed the shape of the letter J, or, according to a note made at the time, the shape of a hockey stick. Whilst this was taking place there was a manifest movement of the whole, as I thought, towards the west. In the space of two or three minutes the light faded away. The whole time, from the brilliant flash till the fading away of the phosphorescent light, could not have been more than three minutes. Perhaps the slight haze hid the light here sooner than at Gloucester.

Northwich, September 9. THOS. WARD.

Drought at Antigua.

[MR. THISELTON-DYER has kindly sent us the following interesting note received by him from the Superintendent of Agriculture, St. John's, Antigua.—ED. NATURE.]

We are suffering from a terrible drought here. I thought you might like to look at the accompanying average prepared for H.E. the Administrator. The *Bryophyllum calycinum* weeds are drying up, and in some parts the Opuntias are dying! No single fall of under 1 inch is of any use to us.

	Jan.	Feb.	March.	April.	May.	June.	July.	
1891	3·74	2·24	0·33	2·82	1·87	4·02	10·04	=25·06
1892	5·81	0·83	0·88	1·18	2·39	3·28	3·15	=17·72
1893	1·77	1·48	2·64	2·14	2·02	2·19	4·63	=16·87
1894	2·02	1·06	1·31	2·84	2·86	1·54	1·73	=13·36

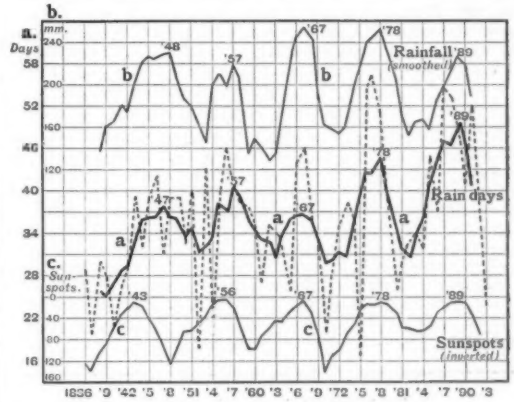
in.

NOTE.—1891 was a fair year with annual fall 3·83 over that for last 20 yrs.
1892 ,, very dry ,, ,, 7·24 below ,, ,,
1893 ,, ,, ,, ,, 6·73 ,, ,, ,,
1894 promises to be worse than any

Antigua, West Indies, August 13. C. A. BARBER.

On Spring Rains in Geneva.

THE variation of rain at Geneva Observatory in spring (March to May), through a long series of years, appears to have been subject to a certain periodicity, to which it might be well to draw attention, even if its (considerable) similarity to that of the sun-spot curve should prove to be merely of a fortuitous nature. In the accompanying diagram, I have dealt with both rainfall and rain days (rain *hours* would have been better than rain *days*, but these extend back only to 1861). The dotted-line curve shows the actual variation in the annual number of rain days, and the continuous curve with it is the result of smoothing with averages of five. Above is a similarly smoothed curve of the spring rainfall, which is very similar (the actual variations are not given). Below is the *inverted* sun-spot curve.



The letters a, b, c, connect the curves with their respective vertical scales on the left. It will be seen that, the sun-spot *minima* occurring in 1843, 1856, 1867, 1878, and 1889, we have in the smoothed rain curves, *maxima* in 1847 or 1848 (but note that the curves rise nearly as high in 1844), in 1857, in 1867, in 1878, and in 1889. In the case of the sun-spot *maxima* (the earlier at least) there seems to be more "lag."

It would be interesting to know what happens in other parts of Europe in this respect. The Paris curve is, I think, like the Geneva one; but Bremen and Berlin present some important differences. A. B. M.

Interesting Marine Animals.

Two rare and interesting animals, which we have had alive and under observation for a week past in the aquarium of the Port Erin Biological Station, are probably worthy of record in the pages of NATURE. The one is the yellow variety (?) of *Sarcodictyon* (*Rhizoxenia*) *catenata*. This was first found by Forbes and Goodsir in the Hebrides, and has been described since by myself from specimens dredged in Loch Fyne in 1883. We have now found it here, off the west side of the Calf Island, in 25 fathoms, and have at present several colonies alive with the polypes expanded. The commoner red form of *Sarcodictyon* is rarely seen expanded, and I do not know that the yellow one has ever been seen in this condition. The polypes are of a beautiful transparent white, and glisten in the light like frosted silver.

The other interesting animal is the Polynoïd worm *Panthalis oërstedi*. We dredge in the deep water near here large muddy sausage-like tubes, which sometimes contain *Panthalis*, but are frequently empty. Some doubt has been felt, however, as to whether the *Panthalis* really builds the tubes, and it is therefore satisfactory to have had the matter definitely settled by the formation of a new tube before our eyes by a living *Panthalis* in the aquarium during the last few days. Mr. Arnold Watson, of Sheffield, who has been studying the formation of Polychæte tubes for some years, after examining our preserved specimens, became anxious to settle the *Panthalis* question, and came here on my suggestion to get living material. I was fortunately able to take a steamer to the ground on the 25th inst., and amongst the tubes brought up in the dredge, from over 50 fathoms, one

contained a fine living *Panthalis*, which was successfully transferred to a small tank provided with a supply of the fine mud in which the animal lives. This worm has been kept under the closest observation by Mr. Watson and his son during the whole daytime and part of the night for the past week, and their care and enthusiasm have been rewarded by the collection of a number of drawings, photographs, and notes of the appearance and movements of the animal. During that time the *Panthalis* has deserted its old tube, and has formed a new one in the mud, fortunately using the glass of the tank for part of one side, so that the processes of scooping out the mud and of putting on the lining of mucous threads, and the various movements of the animal, have been readily enough seen—if one does not mind the inconvenience of lying for hours in a cramped position on the damp concrete floor of the aquarium room. The worm, and Mr. Watson, are still alive and at work, and we may expect a detailed account of their mutual labours from the latter when his observations are completed. W. A. HERDMAN.

Port Erin, August 31.

Symmetry of "Aurelia aurita."

DURING the last few months I have seen countless thousands of living specimens of *Aurelia aurita*, and have paid special attention to abnormal varieties. I have found not only such as have throughout the five-fold symmetry, seen by Mr. Unthank at Brightlingsea, as named in NATURE for August 22, but have with me on the *Glimpse* specimens stained and mounted as lantern slides having entire three-fold and entire six-fold symmetry, and one in which it is partially two-fold. I think it may be said that in Suffolk and Essex, a few such abnormal varieties occur per thousand of the normal. An imperfect four-fold symmetry is much more common. H. C. SORBY.

Yacht *Glimpse*, Burnham, Essex, August 31.

MARS AS HE NOW APPEARS.

STATISTICS are looked upon, as a rule, as hateful things, but nevertheless it would be interesting to know how many people out of the millions who walk this globe will turn at this period a telescope, however small it may be, in the direction of the planet Mars, which is shining so brilliantly in our eastern heavens. Times there were, no doubt, as for instance in the early Babylonian and Egyptian civilisation, when Mars was more generally the subject of scrutiny than to-day, but then the appearance of this intermittent and gradually brightening object made far different impressions on the minds of those early observers. Early it was that the peculiar coloured rays cast by his shining surface on this earth were first remarked. He was known to the Greeks and Hebrews as the fiery planet, and in Sanskrit he was referred to as like "burning coal."

To-day, however, the case is quite different. Many there are who may happen to notice an object more brilliant than usual in the heavens, and make some brief allusion to the fact, and trouble himself or herself no more about it, but it is to the increasing few that his appearance is of the greatest interest. To those who have once made use of even a small telescope to observe the planets, the fact that the nearest, and, it may be added, the most interesting, of them, namely Mars, is approaching us day by day, will be certain to raise a strong desire to catch another glimpse of his disc under such favourable conditions.

So much has been written about the markings of his surface, which represent huge areas of water and land, to say nothing of the most curious network of canals, that reference only to the very recent work on them will here be dealt with.

A few brief remarks, before proceeding, as to the position of the planet in the heavens, and to the approaching opposition.

Firstly, as to position. At the present time Mars is moving easterly in the heavens, situated at the southernmost corner of the constellation of Aries. By September 15 he will have reached his most eastern point, and from that time he will turn in his loop, and continue his apparent journey in the westward direction, passing into the neighbouring constellation of the Fish.

The following table will perhaps be useful to those who have not the data at hand. The times referred to are Greenwich mean time.

Date.		R.A. Noon.	Decln. Noon.	Diam.	Rises.	Transit.	Sets.
		h. m. s.	° ′	″	h. m.	h. m.	h. m.
Sept. 8	...	2 14 36	9 37 N	21·8	8 6	14 59	21 52
18	...	2 15 48	9 49	23·4	7 30	14 24	21 18
28	...	2 11 15	9 42	24·9	6 46	13 40	20 34
Oct. 8	...	2 1 30	9 16	25·6	5 59	12 50	19 41
18	...	1 48 38	8 41	25·7	5 10	11 58	18 46
28	...	1 35 38	8 9	24·6	4 21	11 6	17 51
Nov. 7	...	1 25 29	7 51	22·8	3 29	10 16	16 55

The fact of Mars being the first superior planet reckoning from the sun, his opposition, or in other words, the position in which he is to be found in his orbit when on the same side of the sun as the earth, with all three bodies in a straight line, affords us a good opportunity for studying his surface features. Owing, however, to the non-concentricity of planetary orbits, his distance from the earth at these times is always varying, and this explains why some oppositions are more favourable for observation than others. The nearest approach of Mars to the earth may be approximately given as 35,000,000 miles, his distance at the coming opposition exceeding this number by about 5,500,000 miles.

In consequence of these varying distances, the apparent size of his disc is undergoing changes; thus the conditions at each succeeding opposition are rarely the same.

That the coming opposition is a very favourable one, can be seen from the table given below, and that it will be more favourable than that of 1892 for observers on the northern hemisphere is due to the planet's more northern declination at this period, bringing him above the mists which spoil good seeing near the horizon.

Date of Opposition.				Semi-diameter.
				″
1862 October 5	...	...	...	10·8
1869 February 13	...	...	...	8·2
1873 April 27 ...	...	...	...	9·7
1877 September 5	...	...	...	14·7
1881 December 26	...	...	...	9·2
1884 January 31	...	...	...	8·3
1888 April 10 ...	...	...	...	9·2
1892 August 13	...	...	...	14·7
1894 October 20	...	...	...	12·9

Let us turn our attention now to the observations that have been made up to the present time, and see what has as yet been learnt from a study of the Martian surface. The work to which we are now about to refer hails from the Lowell Observatory, Flagstaff, Arizona, and the observations have been and are continually being made by its founder, Mr. Percival Lowell, who has set his observatory on this spot for the single purpose of carefully studying the surface of Mars during this period of opposition. The old saying that the early bird gets the first worm, can be applied with some force to Mr. Lowell, for he has been rewarded with ample satisfaction for commencing his observations at such an early date. Indeed, perhaps the great value of this series of observations which he is making will be in its very length, for is he not, from a study of his own observations, watching attentively the various stages of a vast aquatic display which becomes more and more distinct the nearer the earth is approached, and therefore must be continually and for a long period observed?

At the commencement of the observations (May 31) the planet was 98,000,000 miles away, and his south pole was directed towards the earth at about 23½°, reaching a maximum dip of 24° on June 22, the disc appearing gibbous to the extent of about one-sixth.

Such being the conditions of seeing, one could look on the planet, so to speak, rotating under one, watching the snowy pole whirling, as a boy might look at his colour-striped top. The observations were thus limited more or less to the southern hemisphere, but occasional glimpses carried one up as far as latitude 40° north The regions most referred to in the observations were the Syrtis Major, all the region of the north pole, that about Solis Lacus, Lacus Phœnicis, and that a little more north of Mare Sirenum and Mare Cimmerium.

The rapid diminishing of the huge snow-cap, which at this period of the planet's summer has been taking place very rapidly, has perhaps been the most prominent feature of this series of observations. Mr. Lowell has noticed a decrease in its diameter of about 7° in as few as fifteen or sixteen days, by no means a small diminution considering the length of the period.

A further very prominent feature of this polar cap is the apparently perfectly elliptical outer edge, which means that the boundary is in reality circular. The narrow dark streak girdling it, and of nearly a uniform breadth, is "clearly water at the edge of the melting snow, a polar sea in short."

On the snow-cap itself, in the region of the great bay situated south, Hellas and Chersonesus, several extremely brilliant parts have been observed, the appearance and behaviour of which have led to the conclusion that we are here dealing with mountains. These at present are accounted for by supposing that the rotation of the planet brings them into such positions that the sun's light can be reflected by them in the direction of the earth, just as a beam of sunlight can be thrown by means of an ordinary mirror. What has led us to believe them to be mountains is the constancy of the positions in which they are, for not only have they been several times observed at this period of opposition, but Mitchell in 1845, in a drawing made at Cincinnati on August 30, and Green in 1877, have both recorded them and in the same position.

Another marking on this polar cap, referred to as "the great rift," seems to be a very conspicuous object. The best time for observing it is when it is, so to speak, end on, or on the central meridian of the planetary disc. Mr. Lowell has likened it to "a huge cart-track coming down to one over the snow," and he has estimated its size as 220 miles broad and 1200 miles in length.

An observation, which is of more importance than one is at first likely to admit, is that concerning the *indefinite* characters of all the markings between the sharp boundary of the snow-cap and the *definite* characters of the continental coast-line. The coast-line was "most salient and clear cut on the western side of the Hour-Glass Sea (Syrtis Major or Mer du Sablier). To the eastward the coast lay in general direction straight, approaching the pole as it stretched eastward. It was indented by numerous bays, but destitute of those comet-tail peninsulas so generally observed connecting it to the chain of islands south. All of these islands, Hellas, Ausonia, and the rest, were vague, without definite contours, and lapsed imperceptibly into the surrounding seas. Even in colour they were less decided than, though of much the same tint, as the continental areas."

With such facts before us, it is hard to believe that we are not observers of a great inundation, which obliterates, or nearly so for a time, all landmarks lying anywhere in the region 20° or more south of the equator. The source of this flood would of course be the rapidly melting snow, and the great volume of water now liberated from the solid form, and forming at the boundary of the cap the dark narrow belt, would be ample to account for the disappearance of islands, blurring of coastlines, and such-like phenomena. Certain are we that these landmarks are *there*, and the only justifiable cause of their dimness of outline and colour is the hypothesis of their partial and sometimes total submersion.

An observation of great interest may be mentioned here, as it deals directly with the great variation of surface markings we have referred to above. The most conspicuous object on the planet's surface at the present time is the large black gulf bounding the melting snow, and situated due south of the Hour-Glass Sea, or Syrtis Minor. This, as Mr. Lowell has previously described it, is clearly water at the edge of the melting snow, or, in other words, a polar sea. On June 4 the polariscope was brought to bear on this gulf by Prof. Pickering, with the result that it was declared to be water, just as the canal in the same region, running north from it, was concluded to be of this substance. This observation simply verified what had previously been thought to be the case from its general appearance and colour; but another examination, at a later date, represented the matter in quite a different light. On July 9 "no trace of the polarisation in the dark spot could be detected," and a more minute examination of the colour of this region showed it to be of a "rich chocolate-brown tint, differing entirely in colour from the bluish-grey regions to the north of it." This reads somewhat different from Lowell's observation on July 9: "Bay a deep blue, looks just as deep water does." Prof. Pickering is of opinion that as the colour of the grey regions does not, he thinks, represent water, he is led to conclude, as far as his observations at present go, that the "permanent water area on Mars, if it exists at all, is extremely limited in its dimensions." This favours to a considerable extent the hypothesis of an inundation.

Let us consider for a moment the observations relating to the appearance of the channels at this time. These, at this season of the Martian southern hemisphere, are generally not so easy of observation, but Mr. Lowell has been able to make out several of them. Those most generally seen were Cerberus to the north of Mare Cimmerium (on June 9 glimpsed as double), Eumenides, Gigas, Titan, Gorgon and Sirenius, all of which lie just to the north of the Mare Sirenum, and at a later date he has seen some in the region of the Lake of the Sun (Solis Lacus), namely Phasis, Eumenides, and Agathodæmon. These channels, including one or two others which we have not mentioned in the above list, have, we may say, the greatest southern latitude, or lie nearest to the south pole, a fact which may or may not be insignificant.

Of course the great inclination of the pole of Mars towards us, renders those on the northern hemisphere more difficult of observation, so that our information is to a great extent restricted. Nevertheless, one is inclined, from Mr. Lowell's drawings, to look upon the channels simply as the watercourses caused by the inundation of the sea on to the land, commencing naturally at the lowest levels, and of course at the water's edge. Out of the nine drawings which he gives, illustrating the positions of the canals observed, eight of them show the majority of the canals in connection with the southern seas, while there is only one instance of a channel not so connected, and that a very short one. This is as it should be if the channels are, so to speak, overflow courses, and accounts also for the invisibility, or at any rate the difficulty of observation of the channels, as a whole, about this time. As the polar cap ceases to melt, the channels should then be at their fullest, and therefore easily visible. The absence of cloud on the planetary surface about this time shows that the aqueous circulation is almost totally brought about by this flood season.

Whatever may be the cause of these channels and

their duplicity at times, cannot be dwelt on here; but that they are the results of a great inundation, seems to be the conclusion which is most compatible with recent observation.

A further fact which has recently attracted particular attention is the frequent observation of bright projections on the terminator of the planet's disc. It may be here simply mentioned that the observations as yet seem to point to the presence of high mountains as the cause of these bright markings.

A discussion of this question will be dealt with, however, in a future article, which will contain a detailed account of the work up to the present time.

Such, then, are some of the facts which have been brought before us by the Arizona observations. Observations at other observatories, such as that of Juvisy, &c., are also at hand, but the weather seems to have been hard on these eager watchers, so the observations are very few. The surface of Mars is still a puzzle to be unravelled, and there are many who are employed in the fascinating work of solving it. One may repeat, what has often been stated before, that in the study of planetary details, the aperture or the size of object-glass is not the most important function for good observations. A keen and patient observer sitting at the eye-piece of a comparatively small equatorially-mounted telescope, if he makes his observations carefully and with due regard to atmospheric conditions for good seeing, can do more useful and valuable work than one who has a large aperture at his disposal, and employs it indifferently. For Martian detail, Mr. Lowell puts the observer first, then the atmosphere, and lastly, the instrument, as the order of weights to be given as factors of a good observation. W. J. LOCKYER.

Note.—In my article on "The Discs of Jupiter's Satellites," which appeared in a previous number of this journal (August 2, p. 320), the table, giving the measurements of the position angle of the 1st satellite, requires a slight alteration, owing to a printer's error in that number of *Astronomy and Astrophysics* from which the table was taken. In the column indicating the initials of the observers, the following measures, 1, 3, 5, 7, 9, 11, ought to be attributed to Prof. Pickering, and the rest to Mr. Douglas. This alteration makes no change in the text necessary, as it was only stated that there was "a mean personal correction of about 7°·1," which, in the light of the revised column, still holds good. The correction, with one exception, simply reverses the names of the observers in each case. W. J. L.

THE ARCHOPLASM AND ATTRACTION SPHERE.

PLATNER in 1886, when dealing with the spermatocytes of helix, showed that the great "nebenkern" in these elements was derived after each division from a coalescence of the spindle-fibres. At the same time he pointed out in the interior of the structure bright refractive points answering in every way to what was then known about the centrosomes. Some time afterwards F. Hermann, in an exquisite description of the karyokinetic process in the spermatocytes of salamander, successfully homologised the great "archoplasm" (as he termed the nebenkern of these cells), on the one hand with Platner's nebenkern, and with the sphere-attractive and archoplasm of Van Beneden and Boheri on the other. I subsequently drew attention to the fact that this archoplasm in the salamander arose by a collection of the spindle-fibres precisely in the same manner as that of helix, *i.e.* these structures (attraction-spheres) in widely separated groups present precisely similar constituents, and arise in a precisely similar way.

The clear appreciation of the mutual equivalence of these bodies is of considerable value, as it paves a way towards the systematic splitting up of a whole group of structures present in reproductive cells, which had all previously been loosely grouped under the head of nebenkerns. Nevertheless, if we accept it, a certain difficulty arises, to which I referred briefly at the time, and to which Dr. Neves has since called my attention in an interesting letter from Kiel:—If the archoplasm of the spermatocytes with its inner constituents is the homologue *in toto* of the attraction-sphere when at rest (Fig. 3), or during the initial phases of mitosis, what is to be said of it in the later phases of this process?

In the attraction-sphere as first described and ordinarily understood in ascaris, the centrosomes, with their light-surrounding zone, occupy the middle of an extended archoplasm which divides with the centrosomes during the course of the mitotic change, but in the case of salamander the archoplasm remains undivided as a rule; and its whole mass is used up in the construction of the spindle, the centrosomes appearing at the apices of the figure related to a radiation of the non-archoplasmic and external protoplasm. Now when the karyokinesis is completed, and the daughter nuclei formed, the centrosomes can be found at the remote sides of the nuclei (as in Fig. 4, *c*, one-half of a dividing spermatocyte of a rat), but the two new archoplasmic masses are being regenerated on each side of the division plane (as in the rat, Fig. 4, *b*). These masses become completely formed, but in consequence of their position are destitute of centrosomes, which must acquire a secondary connection with them; so that at this phase the sphere is divided into two parts in each cell, that which attracts (centrosomes) being at one side of the nucleus, that which is regarded as primarily attractive (the archoplasmic portion of the kytoplasm) on the other. In salamander these anomalous conditions eventually become righted by the centrosomes wandering round the nuclei into the archoplasm.

Turning, however, to a still higher type of vertebrates, the Mammalia, a short time ago I found in the spermatocytes of various forms, besides other and well-known accessory bodies, a great lightly staining nebenkern (archoplasm), which can be determined as arising during the spermatogenesis by a coalescence of the spindle-fibres (Figs. 1, 2, *a*), so that we must regard this body as having the same value as the nebenkern in Amphibia, in Helix, in Echinoderms, or that it is the archoplasmic portion of the attraction-sphere; but at no time, either at rest or during active mitosis, does it contain within its mass the centrosomes! In the resting spermatocytes of the rat (Fig. 2) these bodies lie quite outside the archoplasm (Fig. 2, *c*), they become duplicated, and enter into the formation of a spindle without any connection with the archoplasm (Fig. 1, *c*), which passes further away, and ultimately degenerates (Fig. 1, *a*). The spindle-fibres are constructed anew out of the kyto- and superficial nuclear-plasm, and the mass of substance thus utilised is collected on either side the division plane as the archoplasmic bodies of the daughter cells.

The archoplasm, then, has no permanent existence in these cells, and is of no immediate consequence in the formation of the spindle. The fact, however, that the transitory body formed in mammals from each new crop of spindle-fibres, after each division (Fig. 4) rapidly dissolves and reincorporates itself into the surrounding kytoplasm, is distinctly favourable to the view now gaining ground, that the spindle has a kytoplasmic origin.

From all this it will be seen that we cannot regard the archoplasmic portion of the sphere as a permanent organ of the cell any more than the ripples wind produces are the permanent features of the surface of a pond.

On the other hand, all the more recent investigations concerning normal or karyokinetic propagation of cells, whenever sufficient pains have been taken to insure good

results, show that the centrosomes retain their individuality through every change. Couple with these facts the discovery by Dr. Field of the entry of the centrosomes into the spermatozoa of the echinoderms, and a quite similar state of things I have found to occur in mammals, and there seems much evidence that the centrosomes, unlike the other constituents of the sphere, retain their individuality during successive mitoses, and are incorporated as an essential constituent of the spermatozoa.

Further, the well-known observations of Fol, and more recently those of Fick, show clearly that these bodies assume their old functions as dominants of the attractive process in the initial steps of fertilisation. Their identity through successive generations being thus maintained, the important functions they perform in the division process itself necessitates our regarding them, with Van Beneden, as organs of the cell, although, when viewed in such a light, they will have to be disrobed of their more conspicuous radial and archoplasmic vestments. With respect to these latter, in whatever degree they may be present, it seems an unavoidable conclusion that they can only be regarded as the effect produced by the inconstant action of polarity or whatever power is exercised by the centrosomes on the surrounding kytoplasm.

J. E. S. MOORE.

FIG. 4.

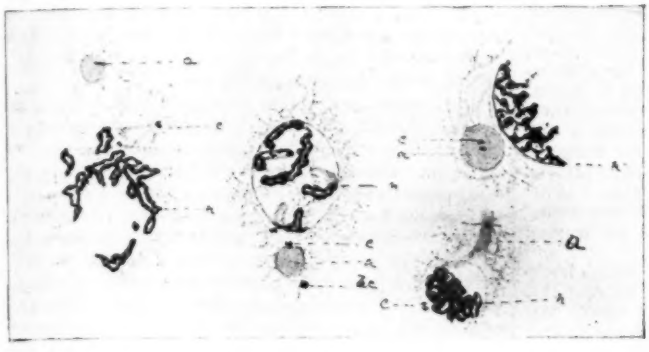


FIG. 1. FIG. 2. FIG. 3.

HERMANN VON HELMHOLTZ.

HONOURED and mourned by all, Prof. von Helmholtz, one of the most brilliant men who have devoted their lives to science, passed away at Charlottenburg, on Sunday last. Shortly before his death, the Empress Frederick sent a telegram of inquiry as to his condition, and upon hearing of his decease messages of sympathy were sent to the sorrowing relatives by the Emperor and herself. This fact is a significant indication of the regard in which the representatives of science are held in Germany.

Hermann Ludwig Ferdinand Helmholtz was born August 31, 1821, at Potsdam, where his father, Ferdinand Helmholtz, was Professor in the Gymnasium, his mother, Caroline Penn, being of an English family. While but a schoolboy he developed a love for science, and studied all the books on physics which his father's library contained. They were very old-fashioned; phlogiston still held sway, and electricity had not grown beyond the voltaic pile. When the class was reading Cicero or Virgil, he was finding the paths of the rays in a telescope, or developing optical theorems not usually met with in text-books. At that time there was little possibility of making a living out of physics, so, acting on the advice of his father, Helmholtz took up the study of medicine. He entered the Army Medical School, the Friedrich Wilhelms Institut, and while there came under the influence of a profound teacher—Johannes Müller. He eventually became a military surgeon, and continued in that position till the end of 1848, when he was appointed Assistant of the Anatomical Museum of Berlin, and Teacher of Anatomy at the Academy of Arts.

In 1847, that is, during his career as an army surgeon, Helmholtz's essay, "Ueber die Erhaltung der Kraft," was published. In this, the principle of the conservation of energy was developed. About Joule's researches on the same subject, he knew at that time but little, and nothing at all of those of Robert Mayer. He was led to write the essay by an examination of Stahl's theory, adopted by most physiologists, which accorded to every living body the nature of a *perpetuum mobile*. The essay contained the results of a critical investigation of the question whether any relations existed between the various kinds of natural forces for perpetual motion to be possible. It was written for the benefit of physiologists, but, to Helmholtz's surprise, the physicists took up the doctrine of the conservation of energy, which some of these were inclined to treat as a fantastic speculation. Jacobi, the mathematician, recognised the connection between the line of thought in the essay, and the principles investigated by Daniell, Bernouilli, d'Alembert, and other mathematicians of last century, and soon the members of the then young Physical Society of Berlin accepted Helmholtz's results. It is unnecessary for us to dwell upon the marvellous influence that these results have had upon physical science during the last half-century. The principle of the conservation of energy has long passed through the debatable stage, and some of the greatest discoveries in thermodynamics and other branches of modern physics have been deduced from it.

In 1849 Helmholtz went to Königsberg as a Professor of General Pathology and Physiology; seven years later he accepted a similar position at Bonn University. While at the former University he designed the ophthalmoscope for the diagnosis of diseases of the inner parts of the eye—a discovery which shows the great importance to the physiologist and physician of a thorough knowledge of physical principles. The year 1859 saw him occupying the chair of Anatomy and Physiology at Heidelberg; and in 1871 he was appointed Professor of Natural Philosophy in the University of Berlin, a post which he held until his death.

The two great works of Helmholtz on "Physiological Optics" and on the "Sensations of Tone," are splendid examples of the application of methods of analysis to the two kinds of sensation which furnish the largest proportion of the raw material for thought. In the first of these works, the colour-sensation is investigated, and shown to depend upon three variables or elementary sensations. The study of the eye and vision is made to illustrate the conditions of sensation and voluntary motion. In the work on the "Sensation of Tone as a Physiological Basis for the Theory of Music," the conditions under which our senses are trained are illustrated in a yet clearer manner. His researches threw a flood of light upon what may be termed the mechanical, physical, physiological, and psychological processes involved in seeing and hearing.

No good end would be served by enumerating Helmholtz's contributions to knowledge. The versatility of his genius is well known among all workers in the realm of nature. Mathematics, physics, physiology, and psychology are but a few of the branches of knowledge which have been enriched by his investigations. His acquaintance with science was not only extensive but

thorough, and, as Clerk Maxwell said in these columns in 1877 (vol. xv. p. 389), the thoroughness was that which of itself demands the mastery of many sciences, and in doing so makes its mark on each. He solved problems with which great mathematicians, since the time of Euler, had occupied themselves in vain. Questions as to vortex motion and the discontinuity of motion in liquids, and the vibrations of sound at the open ends of organ pipes, belong to this class of subjects elucidated by him. In his numerous papers on thermodynamics, he reduced to an intelligible and systematic form the labours and intricate investigations of several independent theorists, so as to compare them with each other and with experiment. Other subjects investigated by him are electrodynamics, stereoscopic vision, galvanic polarisation, the theory of anomalous dispersion, the origin and meaning of geometrical axioms, the mechanical conditions governing the movements of the atmosphere, the production of waves, &c. But even the circle of natural and physical sciences does not embrace all the subjects which he benefited by his keen insight and strenuous energy. He was an acute logician and an accomplished metaphysician. His investigations on perception and observation of the senses led him to study the theory of cognition. The principal conclusion he came to after an examination of the subject, was that the impressions of the senses are only signs for the constitution of the external world, the interpretation of which must be learned by experience.

In 1891, when Helmholtz reached his seventieth birthday, the event was made the occasion of an international celebration. In honour of the anniversary, a marble bust was prepared, and numerous marks of respect were bestowed upon him by his admirers, both in and out of his own country. The German Emperor raised him to the highest rank in the Civil Service; the Kings of Sweden and of Italy, the Grand Duke of Baden, and the President of the French Republic conferred Grand Crosses upon him; many academies, not only of science, but also of the fine arts, faculties, and learned societies representing all parts of the world, sent him diplomas and richly illuminated addresses, expressing their recognition of his scientific labours, and their thanks for his work. His native town, Potsdam, conferred its freedom upon him, and countless individuals sent their congratulations. It was on the occasion of this jubilee that Helmholtz delivered the autobiographical sketch published in the second volume of his "Scientific Lectures," and which has furnished us with some of the particulars contained in the foregoing. He was made a Foreign Member of the Royal Society in 1860, and received the Copley Medal in 1873. He was also one of the Associés Étrangers of the Paris Academy of Sciences, and a correspondent of most important scientific academies and societies all over the world.

Science has had few investigators who have furthered her interests more than Helmholtz. He was constantly exploring new fields of research, or bringing his keen intellect to bear upon old ones. With his contributions he helped to raise science to a higher level. And, while he did as much as anyone to render scientific discoveries understandable to the whole intellectual world, he always recognised that he was in the service of something that should be held everlastingly sacred, a feeling which kept him from playing to the gallery either in his popular works or in his lectures. Many years ago, it was written—

"A wise man instructeth his people, and the fruits of his understanding fail not."

"A wise man shall inherit glory among his people, and his name shall be perpetual."

To no one could these words be more appropriately applied than to the eminent investigator whose loss we now deplore.

NOTES.

WE note with deep regret that Prof. H. K. Brugsch, the distinguished philologist and Egyptologist, died on Sunday last, at the age of sixty-seven.

THE Deputy-Mastership of the Mint, vacated by the resignation of Sir C. Fremantle, K.C.B., will be filled at once by the appointment of a distinguished official, Mr. Horace Seymour, Deputy-Chairman of the Board of Customs. If the post had been destined for a scientific man, it would doubtless have been given to Prof. Roberts-Austen, C.B., but his acceptance of it would have involved his resignation of his chair at the Royal College of Science. The due discharge of the duties of the Deputy-Mastership would, moreover, have left him far less opportunity for research than he has in his present office at the Mint, which he has made such an important one for science. Sir Charles Fremantle has always encouraged original research in his Department, and we wish him much happiness in his well-earned retirement.

THE death of the Comte de Paris recalls the fact that he was a Fellow of the Royal Society. He was elected by ballot on April 27, 1865, and signed the charter book on May 18 of the same year. Under the statutes which were then in force, any foreign sovereign prince or the son of a sovereign prince could be proposed for immediate ballot if he wished to enter the Society. In the case of the Comte de Paris it was found that, according to the strict letter of the statutes, the head and representative of a Royal house might be inadmissible by privileged election, whilst members of the same family of inferior rank were entitled to it. Although he was the hereditary representative of the then late King of the French, yet inasmuch as his father had not been a "sovereign prince," the Society was precluded from extending the courtesy of election, and therefore took steps to amend the statute, and upon being advised that Court usage would accord, introduced words establishing the privilege to "any foreign prince who is received by her Majesty as Imperial Highness, or Royal Highness." It was under such an amended statute that the unanimous election of the Comte de Paris occurred.

THE death of Prof. Josiah Parsons Cooke, LL.D., which took place in Boston, Massachusetts, on Tuesday, is, says the *Times*, not simply a loss to Harvard University, where he has laboured for more than forty-four years, but to the scientific world at large. His work on "The New Chemistry" is well known and highly esteemed, and has been translated into nearly every language of Europe. Born in 1827, he graduated from Harvard in 1848. In the following year he became tutor in mathematics, afterwards instructor in chemistry, and in 1850 Erving Professor of Chemistry and Mineralogy at Harvard. Under his direction the course in chemistry was greatly developed. He was the first in America to introduce laboratory instruction into the undergraduate course. In addition to his duties at Harvard, it was his practice to give courses of popular lectures on chemistry in the cities of Baltimore, Brooklyn, Washington, Lowell, and Worcester, besides his regular lectures at the Lowell Institute in Boston. As director of the chemical laboratory at Harvard he has published numerous contributions to chemical science, most of which have been collected and published in a volume entitled "Chemical and Physical Researches." In 1872 he was elected an honorary Fellow of the Chemical Society, sharing that distinction with only one other American; and in 1882 he was granted the degree of LL.D. by Cambridge University.

THE death is announced of Sir Edward Augustus Inglefield, K.C.B., F.R.S., at the age of seventy-four. The following particulars as to his scientific work are extracted from an

obituary notice in the *Times*:—After seeing a large amount of active service, and earning for himself a high reputation, he was appointed to the command of the yacht *Isabel* in a private expedition which was sent in search of Sir John Franklin to Smith's and Jones's Sound—an experience which partly suggested the interesting story he published under the title of "A Summer Search for Sir John Franklin." Although it failed in its main object, his plucky mission on that occasion enabled him to record the discovery of an open polar sea and a coastline 800 miles in length, while he also had the pleasure of carrying mails to the Government Arctic Expedition at Beechey Island. For these services he received the gold medal of the Royal Geographical Society of London, the large silver medal of Paris, and a much-treasured diamond snuff-box from the Emperor of the French. He was at the same time elected a Fellow of the Royal Society. His first Arctic experience brought him a second like command in 1853, when he went out by order of the Admiralty with three ships, especially despatched to the relief of Sir Edward Belcher's expedition. One of the three vessels was crushed in the ice, and foundered, but he was able to bring home an officer bearing the news of the discovery of the North-West passage. In the following year he received the command of another expedition, consisting of the *Phœnix*, the *Talbot*, and a transport with stores, sent out to afford further relief to Sir Edward Belcher, and this time he brought back the officers and crews of five ships which were abandoned in the ice. For these services he was awarded the Arctic medal, and the honour was signally confirmed by the Queen in 1887, when he was knighted on the occasion of the celebration of the completion of the fiftieth year of her Majesty's reign. To his skill and daring as a seaman Sir Edward Inglefield added a technical ingenuity which has bequeathed to naval engineering the hydraulic steering apparatus fitted in the *Achilles* and the *Minotaur*, the screw-turning engine of the *Monarch*, and the anchor bearing his name, which was supplied to the *Dreadnought*, *Sans Pareil*, *Renown*, *Inflexible*, and other ships. He was a graceful writer and a vigorous speaker, and, beside the book recounting his Arctic researches, was the author of pamphlets on "Maritime Warfare," "Naval Tactics," and "Terrestrial Magnetism."

THE thirty-ninth exhibition of the Royal Photographic Society will open to the public on Monday, September 24. The exhibition will be held, as on former occasions, in the Gallery of the Royal Society of Painters in Water Colours, at 5A Pall Mall East, and will remain open until November 14.

THE Royal Commission appointed last year to inquire into the mode of identification of habitual criminals having reported favourably on the Bertillon system, the Commissioners of Prisons have decided to adopt the anthropometrical system of measurement of criminals. The system will be worked in connection with the present system of identification. From various prisons officers have been already ordered to attend at her Majesty's Prison, Pentonville, to receive instructions from Dr. Garson.

REUTER reports that the members of the Arctic excursion party, organised by Dr. Cook, and noted in NATURE of August 30 (p. 429), have returned to North Sydney, Cape Breton, in the Gloucester fishing schooner *Rigel*. The steamer *Miranda*, by which the party travelled, grounded and sprang a leak on the coast of Greenland. After they had remained on the disabled vessel for some time, the party were taken off by the *Rigel*. The *Miranda* was floated and taken in tow, but foundered on her way home.

A MONUMENT, erected in honour of Armand de Quatrefages, was unveiled at Vallerangue, his native town, at the end of last month. M. Darboux presided over the distinguished company that took part in the ceremony. The scientific labours of the renowned investigator were extolled by MM. Milne-Edwards, Hamy, Geoffroy Saint Hilaire, and Brongniart. Prof. Hamy referred to Quatrefages as the creator of the science of anthropology. The monument is five metres in height, and consists of a bronze bust of the deceased on a stone pedestal, having on its principal face a figure holding in one hand a scientific work, while the other is presenting a crown to the eminent naturalist.

WE learn from the New York *Nation* that the Marine Biological Laboratory at Wood's Holl, Mass., has concluded its seventh summer session, the most successful in its history. The number of students and investigators in attendance was 133, representing seventy colleges and high schools. Courses of instruction in zoology and botany were offered, a new building for the accommodation of the students in the latter course having been erected. The important part played by the Laboratory in the development of the biological sciences in this country is evidenced by the fact that no less than fifty-eight of those in attendance were carrying on research in zoology, botany, or physiology, and that several important investigations were completed during the summer. A number of the lectures delivered at the Laboratory during the session will as in former years, be published in book form.

MR. H. GARNETT informs us that while boating with a friend on the River Avon, just above Evesham, on August 11, he had a good view of a white swallow flying amongst a flock of others very near the ground. Its companions were apparently persecuting it. Finally it flew across the river close over the observers' heads, and this view was sufficient to convince them that it was the common swallow, and not one of the martins. Curiously, it was not a snow-white, but apparently a very pale uniform cream colour. In connection with Mr. Garnett's observation, it is worth remark that the current number of *Science Gossip* contains a note on a white variety of the common sparrow, shot at Ripley on August 13; and Mr. E. W. Atkinson, writing to the *Zoologist*, says that he recently saw a white swallow at Harswell, in the East Riding of Yorkshire.

OF all the sciences, meteorology is probably the farthest from perfection. Many dabble in it, but few seriously attempt to reduce the abundance of observations to law and order. One of the reasons for this state of things is that, so far as we can remember, none of our educational institutions include systematic courses of meteorology in their curricula. There is practically no field for professional meteorologists, and therefore no training-school exists. For the sake of the science we are glad to note, however, that the Board of Regents of the University of California has decided to establish a course in meteorology in that University. Through the course of study and investigation which the students of meteorology will prosecute at the University, valuable additions to knowledge may be expected.

M. DE FONVIELLE calls our attention to one of Roger Bacon's essays, published in 1618, in which some of the possibilities of steam are vaguely foreshadowed, and aërial navigation is declared to be a thing of the future. We quote from a translation with which he has furnished us, and which reads like Mother Shipton's prophecies. "Instruments may be made for navigating without any men pulling the oars, with a single man governing, and going quicker than if they were full of pulling men. Waggons also can be made so that without any horse they should be moved with such a velocity that it is impossible to measure it. . . . It is possible also to devise instruments for flying, such that a man being in the centre if revolving something by which artificial wings are made to beat the air in the fashion of the birds. . . . It is also possible to devise instruments which will permit persons to walk on the

bottom of the sea. . . . All these things have been done in old times and in our times, except the instrument for flying, which I have not seen, and I have not known any man who saw it done."

THE portion of Lord Salisbury's address which refers to the periodic law was not delivered in exactly the same form that it was printed in the official copy. A correspondent of the *Chemical News* points out that in the printed report (see NATURE, August 9, p. 340) the following passage occurs:—"In the last few years the same enigma has been approached from another point of view by Prof. Mendeléeff. The periodic law which he has discovered reflects on him all the honour that can be earned by ingenious, laborious, and successful research." Before the address was delivered, Lord Salisbury became aware of the claim of Newlands as the first discoverer of the periodic law, and the words actually spoken in the Sheldonian Theatre were:—"In the last few years the same enigma has been approached from another point of view by our own countryman Newlands and by Prof. Mendeléeff. The periodic law which they have discovered, &c." Unfortunately, the address was already printed and distributed to the press before the alteration was made. The claim of Mr. Newlands is secured to him by the award of the Davy Medal in 1887 by the Council of the Royal Society.

WRITING from Table Cape, Tasmania, Mr. H. S. Dove says that a fine aurora was witnessed there early on the morning of July 21, from about 12.30 until a few minutes after 1. The whole of the western, southern, and a good deal of the eastern heavens was illuminated by a strong red glow, paling to a delicate pink at the edges. The glow was brightest about half-way between the horizon and zenith, but was discernible over the whole space between those two boundaries, and when it paled and faded in the west would spread and become very vivid towards the east. The broad vertical white stripes which usually accompany these auroræ were also noticeable, but the most uncommon feature of the phenomenon was the presence of brilliant white flashes which shot upwards in rapid succession, spreading out into a fan-shape as they rose, and instantly disappearing. These were principally seen about the Southern Cross, where the vertical stripes were also brightest, the region about that constellation appearing to be the centre of a great electrical disturbance. A low bank of clouds lay along the horizon under the aurora, and a stream of white fleecy clouds sailed up from about west-north-west, but preserved almost a straight line on the edge next the phenomenon, as if something in the highly electrical state of the atmosphere there prevented their spreading in that direction. A note concerning the same aurora appeared in our issue of August 30.

A NEW department of the Pasteur Institute in Paris has recently been established, having for its special object the experimental study of means of defence against destructive insects. The new section—Station expérimentale de l'Institut Pasteur—as it is called, has (says the *Revue Scientifique*) been placed under the superintendence of M. Metchnikoff, with M. J. Danysz as assistant. The department will be concerned with the following points: (1) The collection and cultivation of all the pathogenic microbes of insects and animals destructive to crops; (2) the study of the conditions of development of these microbes in animals and on various media; (3) the direction of field-experiments; (4) the superintendence and control of practical applications of the results of laboratory work. The best means of applying these results will be discussed by a *Comité d'études* consisting of naturalists, agriculturists, and some specialists in mycology, bacteriology, and agriculture, such as MM. Brocchi, Costantin, Grandeau, Millardet, Sauvageot, Schribeaux, A. Giard, J. Künckel d'Herculis, A. Laboulbène, P. Marchal, and E. L. Ragonot, of the Société entomologique of France. A *Bulletin* will be published, containing notes and communications to the station and the committee, and the proceedings of meetings. It is also proposed to give monographs of destructive insects and pathogenic microbes; statistics concerning the damage done by harmful animals; and critical notes on all publications referring to these matters. In connection with the Laboratoire de Parasitologie of the Bourse de Commerce and the entomological station of Paris, the new section of the Pasteur Institute will render excellent service to French agriculture.

WE have received from the *Deutsche Seewarte* its report for the year 1893; it is issued as an appendix to the *Annalen der Hydrographie*, from which useful publication we have frequently had occasion to quote. The report shows that much good work is being done, but to which we can now only briefly refer. In the department of maritime meterology, great activity is shown in the collection and utilisation of observations made on board ships of both services, the number of co-operators during the year amounting to 430 for the mercantile marine alone. The results are published in tables for one-degree squares of the North Atlantic, in the daily synoptic charts issued in connection with the Danish Meteorological Institute, and in the preparation of atlases for different oceans, the one now in hand being for the Pacific. Similar activity is also shown in the department for weather prediction, and the daily weather reports issued by it are among the most complete that are published; they contain full particulars of the weather twice or thrice daily, at about 100 stations all over Europe, in addition to the usual weather charts and summary of existing conditions.

IN a paper read before the Asiatic Society of Bengal, Dr. R. Havelock Charles calls attention to the incomparability of nasal indices derived from measurements of the living head with those deduced from observation of dry skulls. The author carefully measured the nasal diameters of sixty-two "subjects," of various castes, and then having removed the integuments, &c., and cleared the naso-frontal suture and anterior nasal aperture, he again measured the diameters. The results are certainly somewhat startling. The height of the nose taken on the undissected head is almost invariably less than the long diameter of the nose measured on the skull of the same head, the difference amounting, in one case, to as much as 16 mm. The higher the caste the greater the discrepancy, but it may be reckoned to be upon an average about 4 mm. in the higher races. The transverse diameter of the anterior nasal aperture, taken on the skull, is less than the breadth of the nose taken on the head of the same subject. The difference is usually 7 mm., and in the lower castes it may be as much as 9 mm. or even 11 mm. Also, other things being equal, the older the individual the greater is the difference between these measurements. Hence, we see that the nasal index deduced from observations on the skull must always be lower than the index calculated from measurements taken upon the head; and, therefore, the *skull* nasal index will place a race upon a higher platform than the *head* nasal index.

THE *Rendiconti del Reale Istituto Lombardo* contain a paper by Profs. Bartoli and Stracciati on the effect of a thin veil of cloud or mist upon the intensity of solar radiation. This effect was brought out in a striking manner by choosing from among some thousand pyrheliometer observations made at Catania and at Casa del Bosco, on Etna (4725 feet above sea-level), those which corresponded to the same altitude of the sun and to approximately the same hygrometric state of the atmosphere. It was found that a stratum of cirrus clouds interposed in the path of the sun's rays was capable of intercepting up to 30 per

cent. of the radiant energy. When the sky was of a light blue colour, but quite cloudless, the absorption was greater than in the case of a deep azure sky. The ratio of the amounts of heat transmitted ranged from 77 per cent. with an altitude of 10° above the horizon, to 96 per cent. at 50°. The effect of a slight mist equally distributed in every direction was somewhat undefined, since the ratio of the absorptions does not appear to vary regularly with the thickness of the stratum of air. In one pair of cases, with the sun at 45° 15′, the quantity of heat received during one second by 1 square cm. of the pyrheliometer surface was 0·0237 with a deep blue sky, and 0·0201 with a slight mist. With the sun at 9° 42′ the figures were 0·0161 and 0·0093 respectively. In general, the ratio varied between 58 and 92 per cent.

AT the Adelaide meeting of the Australasian Association for the Advancement of Science, the committee appointed to collect evidence as to glacial action in Australasia, in Tertiary or post-Tertiary time, presented their report. The conclusions arrived at are as follows:—At the time of their greatest extension the ancient glaciers of New Zealand were larger and descended lower the further they were south. The terminal moraines in North-West Nelson go to 2700 feet above the present sea-level; Lake Rotoiti, in South Nelson, to 2000 feet; Lake Sumner, probably a glacier lake, is 1700 feet above the sea. In South Canterbury the terminal moraines are 1000 feet, and in South Otago only 600 feet above the present sea-level. In Westland and in the West Coast Sounds the glaciers advanced to below the present sea-level. The glacier of Boulder River was four, and that of Lake Rotoiti about twelve miles in length; the glacier at the head of the Waiau-ua or Dillon, fourteen miles; that of the Rakaia, fifty-five miles; the Wanaka glacier, sixty; that of Wakatipu, eighty; and that of Te Anau, sixty-five miles in length. There is, therefore, a considerable difference in relative proportion between the ancient glaciers and their present representatives. At present they reach their maximum in South Canterbury, and get smaller both to the north and to the south; while in ancient times their maximum was in Central Otago. The committee had little biological evidence to report upon, but what there is indicates that the ocean round New Zealand has not been much colder than at present ever since the Miocene period.

THE Glasgow and West of Scotland Technical College has issued its Calendar for the session 1894-95. Another Calendar just received refers to the Mining School at Houghton, Michigan, and contains information concerning the institution and its courses of instruction.

THE current number of the *Quarterly Journal of the Royal Meteorological Society* contains a portrait of Luke Howard, the author of the system of cloud nomenclature in general use, together with a biographical notice of him. The papers in the *Journal* include one by Mr. W. H. Dines, on the duration and lateral extent of gusts of wind, and the measurement of their intensity; and another, by the same author, on the relation between the mean quarterly temperature and the death-rate. The calculation of photographic cloud measurements is described by Dr. G. K. Olsson, and Mr. Inwards' address on phenomena of the upper air, delivered before the Society in April last, is printed in full.

A CALENDAR of the Evening Classes to be held at the People's Palace, Mile End Road, during the Session 1894-95, has been sent to us. Under the direction of Mr. J. L. S. Hatton, the number of these classes has been largely increased. In addition to the usual scientific and technological subjects, instruction is offered in astronomy, brass-work, bookbinding, instrument making, differential and integral calculus, determinants, trilinear co-ordinates and advanced co-ordinate geometry of three dimensions, and practical physics. The Drapers' Company have voted the sum of £5000 for the erection of new engineering workshops, and several new laboratories have been constructed. More than 8000 class-tickets were issued last session, and there is every prospect of this number being increased during the coming one.

TO the current number of *Science Progress*, Prof. W. Halliburton, F.R.S., contributes a paper in which he emphasises the importance of further study of blood coagulation and the poisonous proteids secreted by snakes. Mr. A. C. Seward shows that algæ have a much greater claim to the attention of geologists as possible agents of rock construction than has generally been admitted. Fossil algæ is also the subject of a paper by Mr. George Murray. Dr. George A. Buckmaster describes the biological characters of *Bacillus typhosus* (Eberth) and *Bacterium coli commune* (Escherich). In a paper on ancient volcanic rocks, Mr. Alfred Harker compares the views of continental petrologists, who hold that there is a fundamental distinction between the "older" (that is, pre-Tertiary) volcanic rocks and the "younger" (Tertiary and Recent), with the conviction of English students, that the supposed differences are due to the fact that the former are, as a rule, more affected than the latter by the changes which come with lapse of time. Mr. E. H. Griffiths writes on the measurement of temperature, and shows that mercury thermometers are hardly comparable in point of accuracy with the platinum thermometer.

AN account of the striking changes which the great lava lake in Kilauea has undergone this year, appears in the *Hawaiian Gazette* for July 24, a copy of which the Hon. Rollo Russell has sent us. The lava steadily rose after the last great breakdown of the floor of the crater in March 1891, when an area of 2500 feet long, by 2000 feet wide, fell more than five hundred feet in one night. Towards the end of last year, the rising and overflowing of the lake filled the pit thus produced. Since that time the activity of the lake has been intense, as many as twenty-three overflows of liquid lava having taken place in a single day, and the walls surrounding the lake have been rapidly raised by continual overflows. Accurate measurements of the lake were made by Mr. F. E. Dodge, of the Survey Department, in August 1892 and March 1894. From his observations it appears that in August 1892 the outer rim surrounding the lake was 282 feet below the level of the Volcano House. The surface of the lake was 240 feet below this line. In March, 1894, the surface of the lake was 207 feet above this line, making a rise of 447 feet in nineteen months. But the most interesting observations relate to the breaking down of the lake, witnessed by a number of persons in July last. On July 11 the lava began to sink steadily, falling at the rate of about twenty feet an hour. This subsidence caused the banks to give way. We quote from the *Gazette*:—"From about noon until eight in the evening there was scarcely a moment when the crash of the falling banks was not going on. As the level of the lake sank, the greater and greater height of the banks caused a constantly increasing commotion in the lake as the banks struck the surface of the molten lava in their fall. A number of times a section of the bank from 200 to 500 feet long, 150 to 200 feet high, and 20 to 30 feet thick, would split off from the adjoining rocks, and with a tremendous roar, amid a blinding cloud of steam and dust, fall with an appalling down-plunge into the boiling lake, causing great waves to dash into the air, and a mighty 'ground swell' to sweep across the lake, dashing against the opposite cliffs like storm waves upon a lee shore. Most of the falling rocks were immediately

swallowed up by the lake, but when one of the great downfalls referred to occurred, it would not immediately sink, but would float off across the lake, a great floating island of rock. At about three o'clock an is land of this character was formed estimated to be about 125 feet long, 25 feet wide, and rising 10 to 15 feet above the surface of the lake. Shortly after, another great fall took place, the rock plunging out of sight beneath the lava. Within a few moments, however, a portion of it, approximately 30 feet in diameter, rose up to an elevation of from 5 to 10 feet above the surface of the lake, the molten lava streaming from its surface, quickly cooling, and looking like a great rose-coloured robe, changing to black. These two islands, in the course of an hour, floated out to the centre, and then to the opposite bank. At eight in the evening they had changed their appearance but slightly, but the next morning they had disappeared." It was observed that, as the falls occurred, the exposed surface, sometimes more than 100 feet across, was left red-hot. Sometimes a great mass would fall forward like a wall; at others it would simply collapse and slide down, and again enormous boulders, as big as a house, singly and in groups, would break from their fastenings, and, all aglow, leap far out into the lake. It is believed that this is the first break-down of Kilauea that has taken place in the presence of observers, those prior to 1868 being before the establishment of the Volcano House, and those of 1868, 1886, and 1891, and several minor ones, all having occurred at night when no one was present.

THE additions to the Zoological Society's Gardens during the past week include a Slender Loris (*Loris gracilis*) from Ceylon, presented by Miss Grace Thomson; two Wild Swine (*Sus* sp. ?) from Turkish Arabia, presented by Mr. F. G. Beville, H.B.M. Consul; three Agoutis (*Dasyprocta* sp. ?) and two Orange-winged Amazons (*Chrysotis amazonica*) from the Island of Tobago, presented by the Hon. W. Low; a Raven (*Corvus corax*), European, presented by Mr. Ogilvie Grant; a Green Turtle (*Chelone viridis*) from the West Indies, presented by Mr. E. Leach; a Japanese Teal (*Querquedula formosa*) from North-eastern Asia, purchased; a collection of Marine Fishes, purchased; two Shamas (*Cittocincla macrura*) from India, received in exchange; a Brazilian Blue Grosbeak (*Guiraca cyanea*), and a Red-headed Marsh Bird (*Angelæus ruficapillus*) from Brazil, received in exchange; and a Diana Monkey (*Cercopithecus diana*) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN.

THE HARVEST MOON.—This year's Harvest Moon will be exceptionally conspicuous. On the day of full moon, September 14, the ascending node of our satellite's orbit will be only 1° 35′ from the vernal equinox. The inclination of the orbit to the horizon will therefore be very nearly the same as if the node were exactly at the equinox. Owing to this, the moon is longer above the horizon than she is at other times of the year. On the average, the moon rises fifty-one minutes later every night; but for a few evenings before and after the coming full moon, the average interval is only about ten minutes.

ECLIPSE OF THE MOON.—A partial eclipse of the moon, partly visible at Greenwich, will occur early on Saturday morning. The first contact with the penumbra takes place at two o'clock in the morning, the first contact with the shadow at 3h. 36m., and the middle of the eclipse happens at 4h. 32m. The last contact with the shadow will occur at 5h. 27m. As the moon sets shortly after, the last contact with the penumbra will not be observable. Taking the moon's apparent diameter as equal to 1, the magnitude of the eclipse = 0 225.

M. TISSERAND ON SATELLITE-ORBITS.—M. Tisserand's recent investigations on the satellite of Neptune have already been referred to in these columns (vol. xlix. p. 543). He has shown that the equatorial protuberance of Neptune causes the direction of the major axis of the orbit of the satellite to change, and that the reaction of the satellite itself modifies the position of the plane of the planet's equator. As the mass of the satellite is comparatively small, the latter effect can be neglected for a considerable period of time. But when the difference of mass between a primary and its companion is not great, the case is altered. In the *Bulletin Astronomique* for August, M. Tisserand investigates the various conditions affecting the secular displacements of the equator of a planet and the satellite-orbit. He cites the Algol system as a case in which the two members—that is, the luminous star and the dark companion revolving round it—have comparable masses. The distance separating the pair is also commensurate with their dimensions. Under these conditions, the variations of the equator and those of the orbit of the satellite, can be treated at the same time. The secular inequalities undergone by the equator and the orbit doubtless cause the proportion of the bright star's disc eclipsed by the dark companion to vary with the lapse of ages. A secular change in the range of variability must result from this. Observations extending over a long interval of time should also show changes in the periods of variables like Algol. M. Tisserand considers cases of this kind and develops the formulæ relating to them. The discussion of the formulæ is reserved for a future communication.

THE DISTRIBUTION OF NEBULÆ AND STAR-CLUSTERS.—Mr. Sidney Waters has mapped the positions of the nebulæ and star-clusters—7840, in all—contained in the New General Catalogue, and two excellent lithographed charts, given in the number of *Monthly Notices*, R.A.S., just issued (vol. liv. No. 8), show the results of his labours. The Milky Way is drawn upon the charts, the portion for the northern heavens being taken from Dr. Boeddicker's fine maps, while that in the southern heavens is copied from the *Uranometria Argentina*. Mr. Waters designed the maps with two objects. First, to study the distribution of nebulæ and clusters of stars, and, secondly, to guide astronomers engaged upon the observation of nebulæ to fields of research. Clusters are shown upon the charts by means of red crosses, resolvable nebulæ by red dots, and irresolvable ones by black dots. The distribution of these objects is thus taken in at a glance. Whether, in the light of recent research, it was desirable to continue to recognise this difference between nebulæ is a matter of opinion; one point in favour of the distinction is that it was followed in similar maps drawn by Mr. Waters and laid before the Royal Astronomical Society in 1873, so that the two sets are easily comparable. The present charts show very clearly the peculiarities of the distribution of clusters and nebulæ. Referring to the former, Mr. Waters says: "It is striking to note the fidelity with which they follow not only the main track of the Milky Way but also its convolutions and streams. They appear in many parts to seek out the denser regions, and to avoid with an equal persistence the dark spaces." As to nebulæ, we read (and the maps bear out the remarks): "A proportionate scattering of resolvable nebulæ follow the others throughout the charts, showing that they are probably intermixed, and that the resolvability of many of them must not necessarily be regarded as a criterion of their distance. The remarkable avoidance of the nebulæ of the galaxy, although in some points reaching up to and encroaching upon its edges, is equally significant with the coincidence of the clusters with its main track." It is pointed out that the exceeding nearness to one another of very many of the nebulæ suggests the probability of physical connection analogous to that of double stars, hence long-continued observations may lead to the detection of similar orbital motions. Other fields of research are suggested by the charts, and by exploring them new light will certainly be thrown upon the structure of the sidereal universe.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A GENERAL account of the recent meeting of the American Association for the Advancement of Science was contributed to our last issue by Dr. W. H. Hale. We are now able to give a few extracts from presidential addresses, together with descriptions of some of the papers read before the different sections.

In the course of his reply to the address of welcome to

Brooklyn, Dr. Daniel G. Brinton, the President, thus expounded the aims of the Association.

"The influence of our Association is in the highest and best sense of the word educational. Its discussions are aimed to present the correct methods of scientific investigation and to be guided by the true spirit of scientific inquiry.

"The goal which we endeavour to attain is scientific truth, the one test of which is that it will bear untrammelled and unlimited investigation. Such truth must be not only verified, but always verifiable. It must welcome every test, it must recoil from no criticism, higher or lower, from no analysis and no scepticism. It challenges them all. It asks for no aid from faith; it appeals to no authority; it relies on the dictum of no master.

"The evidence, and the only evidence, to which it appeals or which it admits is that which it is in the power of every one to judge, that which is furnished directly by the senses. It deals with the actual world about us, its objective realities and present activities, and does not relegate the inquirer to dusty precedents or the mouldy maxims of commentators. The only conditions that it enjoins are that the imperfections of the senses shall be corrected as far as possible, and that their observations shall be interpreted by the laws of logical induction.

"Scientific truth has likewise this trait of its own: it is absolutely open to the world; it is as free as air, as visible as light. There is no such thing about it as an inner secret, a mysterious gnosis, shared by the favoured few, the select *illuminati*, concealed from the vulgar horde or masked to them under ambiguous terms. Wherever you find mystery, concealment, occultism, you may be sure that the spirit of science does not dwell, and what is more, that it would be an unwelcome intruder. Such pretensions belong to pseudo-science, to science falsely so called, shutting itself out of the light because it is afraid of the light.

"Again, that spirit of science which we cultivate and represent is at once modest in its own claims and liberal to the claims of others. The first lesson which every sound student learns is to follow his facts and not to lead them. New facts teach him new conclusions. His opinions of to-day must be modified by the learning of the morrow. He is at all times ready and willing to abandon a position when further investigation shows that it is probably incorrectly taken. He is in this the reverse of the opinionated man, the hobby rider and the dogmatist. The despair of a scientific assemblage is the member with a pet theory, with a fixed idea, which he is bound to obtrude and defend in the face of facts. Yet even towards him we are called upon to exercise our toleration and our charity, for the history of learning has repeatedly shown that from just such wayward enthusiasts solid knowledge has derived some of its richest contributions.

"All this prying into the objective, external aspect of things, this minute, painstaking study of phenomena, this reiterated revision and rejection of results, are with the single aim of discovering those absolute laws of motion and life and mind which are ubiquitous and eternal, which bear unimpeachable witness to the unity and the simplicity of the plan of the universe, and which reveal with sun-clear distinctness that unchangeable order which presides over all natural processes.

"This is the mission of science—noble, inspiring, consolatory, lifting the mind above the gross contacts of life, presenting aims which are at once practical, humanitarian, and spiritually elevating."

Mathematics and Astronomy.

The address of the vice-president of Section A (all the sectional presidents are termed vice-presidents) was summarised in our last number. In this section Prof. George E. Hale gave an interesting paper on "Some Attempts to Photograph the Solar Corona without an Eclipse."

C. W. Hough presented a method of control of the equatorial driving clock, based on a description published in the Transactions of the Albany Institute in 1871.

W. R. Warner, on "Requisites for Governing the Motion of Equatorial Telescopes," told of the differing resistance produced by weather, oil, or the lack of it, &c., which a driving clock must overcome in order to run accurately.

Prof. Doolittle exhibited a large diagram showing the results of the recent latitude determinations at the Sayre Observatory, of South Bethlehem, Pa. The Chandler theory and these observations differ so much that one can hardly be called an approximation of the other. Prof. Doolittle finds a dimunition in the mean value of the latitude which is entirely unaccounted for.

Physics.

The subject of the presidential address to this section was "Obscure Heat as an Agent in producing Expansion in Metals under Air Contact." The address contained the results of a study of the forces under which the expansion and contraction of metals take place, under the conditions in which they are used in every-day experience. Among the papers communicated to the section was one by Miss Mary Noyes, on the influence of heat and electricity upon Young's modulus for a piano wire. It appears that the effect of heat is to make the modulus less. Magnetism has no effect. The passage of a current of electricity through the wire causes the modulus to diminish more than can be accounted for by the heating effect.

W. Hallock, of Columbia College, who has photographed sensitive flames, exhibited specimens.

Dr. Bedell presented a paper by Prof. Nichols and Miss Crehore, of Cornell University, giving studies of the lime-light. They have examined the light from the lime cylinder of the Drummond light, by means of a spectro-photometer.

In a paper upon aluminium violins, Mr. Springer discussed their merits. He said that soundboards made of aluminium differed from those made from other metals, and were analogous to those of wood. They did not produce secondary tones which were not in harmony with the prime tones. There were many difficultities to be overcome in the manufacture of violins from aluminium. The material could not be soldered satisfactorily, and had to be rivetted. As uneven thickness could not be secured for the belly and back, it was necessary to rib and arch the metal. In conclusion, he said: "My experiments incline me to believe that the real cause of the superiority of old wooden instruments over new ones is not so much in the elasticity of the wood or in the composition of the varnish, but in the peculiar warping of the wood to a higher arch, a buckling caused by the position of the F holes and sound-post. I have never seen a good old instrument which was not thus warped. Moreover, I believe if a new wooden instrument were immediately so constructed, while good at first, would deteriorate because further arching would produce rigidity and consequent veiling of tone. Time has no such effect on aluminium violins, as they remain practically unaltered; one which has been used daily for the last two years shows no signs of crystallisation. A perfect instrument would consequently retain all of its good qualities, and could easily be duplicated."

Two papers of considerable interest were read, one by A. McAdie, on some peculiar lightning flashes, and the other on a phonographic method of recording the change in alternating electric current, by C. J. Rollesson.

Mr. McAdie said that in the month of June, 1894, there were one hundred persons killed by lightning in the United States. It is, therefore, important to get accurate knowledge about lightning discharges, especially in reference to the length and form of the path of lightning, so as to discover its energy. Mr. McAdie has three cameras pointed at the top of the Washington Monument, in the city of Washington; one at the Capitol, a second at Fort Myer, and the third at the Weather Bureau. He wishes to obtain three simultaneous photographs of a lightning discharge, but though he has watched since May, he has not been successful.

Mr. Rollesson said that two operations were necessary to produce the alternating current curve by the aid of the phonograph: first, a record of the curve must be produced on the wax cylinder of the phonograph; second, the record produced in the second operation must be magnified by means of a suitable multiplying arrangement. The method described was especially adapted for the study of harmonics in the alternating current.

Chemistry.

The subject of Prof. T. H. Norton's address was "The Battle with Fire, or the Contributions of Chemistry to the Problem of Preventing Conflagration." We hope to be able to print this address in full in a future issue.

Among the papers read before the section was one upon observations regarding certain European water supplies, by William P. Mason. It was shown that the difference in the death-rate of various towns and cities in Europe, caused by improvement in the water supplies, varied from 2 to 13 per cent. "Fallacies of Post-mortem Tests for Morphine" was the title of a paper by David L. Davoll. Other papers before this

section were on the behaviour of allylmalonic, allylacetic, and æthylidenpropionic acids when boiled with caustic soda solutions, John G. Spenzer; camphoric acid, W. A. Noyes; double halides of antimony and potassium, Charles H. Herty; some peculiar forms of iron. T. H. Norton; on the existence of ortho-silicic acid, T. H. Norton; volatility of certain salts, T. H. Norton; a new formula for specific and molecular refraction, W. F. Edwards; action of nitric acid upon the chlorides of zinc, bismuth, and cadmium, O. C. Johnson; and a convenient milk sampling tube, M. A. Scovell.

Mechanical Science and Engineering.

Dr. Mansfield Merriman delivered an address before Section D, on "the resistance of materials under impact." He pointed out that the science of the resistance of materials, as taught in text-books, and used in the daily practice of every engineer, was mainly that of static conditions where external force is resisted by internal stress. The question of resistance to the impact of falling bodies, likely to occur in machinery, on bridges, and to a certain degree also in buildings, is recognised as important, but it is seldom reduced to computation or made the occasion of careful experiment. Even the fundamental principles and laws regarding it seem often not clearly understood. Dr. Merriman's address was an attempt to set forth the present state of knowledge concerning impact, and to reconcile some of the apparent paradoxes that often arise in the discussion and application of its principles.

The first paper before the section was on the crank curve, by J. H. Kinealy, secretary of the section. In this paper a simple graphical method was given for determining the velocity of the piston of a steam engine for a given positon of the crank. The next paper was on preliminary experiments on a new air pyrometer for measuring temperatures as high as the melting point of steel, by D. S. Jacobus. Experiments made at the Stearns Institute show that three pyrometers gave concordant results in measuring extremely high temperatures.

Another paper, by Prof Jacobus, was on improvements in methods of testing automatic fire sprinkler heads. Automatic fire heads for extinguishing fires have now come into common use. In these a valve is opened automatically in case of fire, by the melting of a fusible solder piece, and the water from this valve puts out the fire. The method of making tests on such heads was described in detail. A paper, by Prof J. E. Denton, was read on the ratio of the expansion of steam in multiple expansion marine engines for maximum economy in East River steamers. This was followed by a paper by Samuel Marsden, on experiments on the transverse strength of long-leaf yellow pine. The results of numerous experiments were presented. The last paper was by Elmo G. Harris, on the air-lift pump.

Geology and Geography.

The president of this section, Samuel Calvin, took for his subject "Niobrara Chalk." The Niobrara stage of the Upper Cretaceous is well represented along the Missouri, from the mouth of the Niobrara River to the mouth of the Big Sioux. East of the Sioux, beds of the same stage are found at various points in Iowa as far eastward as Auburn in Sac country, while fossils distributed through the drift indicate the former existence of cretaceous strata at points many miles farther east than any locality where they are not known to occur in place. The general distribution of the Niobrara deposits covers an area reaching from Western Iowa to the Rocky Mountains, while north and south it stretches from Texas to Manitoba, and probably northward to the Arctic Ocean. The address was limited, however, to a description of some of the characteristics of the Niobrara chalk exhibited in the somewhat restricted region lying between the mouth of the river from which the formation takes its name, and the most eastern exposure of the beds at present known, near Auburn, Iowa.

Major J. W. Powell read a paper on the water resources of the United States. Mr. Powell said that the ultimate development of the United States rested largely upon the most thorough utilisation of the water resources. This was conspicuously true of the vast arid and sub-humid regions extending from the great plains to the Pacific coast. There the almost boundless extent of fertile land could not be utilised for agriculture without the artificial application of water. In all cases, whether in arid or in humid regions, the proper solution of the problem rested upon the correct knowledge of the distribution and fluctuation of the available water. This study had been begun by the United States Geological Survey, and was now being carried on.

Prof. W. J. McGee read a paper by F. H. Newell, on the Geological Atlas Folio issued by the United States Geological Survey. These folios are the final maps of the survey showing the topography, geology, and the mines of the areas covered by the sheets. Accompanying the maps are the descriptions of the same in popular rather than technical language, for the benefit of the people. The folios have involved a great expense, and represent probably the finest specimens of geological lithography that are known.

Mr. Joseph H. Hunt described briefly the minerals from Paterson, Upper Montclaire, N.J., and the Palisades, and exhibited excellent specimens, some of which showed in a beautiful manner the process of alteration of one mineral into another.

Dr. W. H. Dale, in a paper, entitled "Notes on the Atlantic Miocene," showed that the vast deposits of phosphate rock of South Carolina, which have yielded millions of dollars, are of Miocene age, like those of Florida.

Prof. Spencer read an interesting paper upon the age of Niagara Falls. He said that the first conjecture as to the age of Niagara Falls was made by Andrew Ellicott in 1790, who supposed the Falls to be 55,000 years old. About 1841 Lyall estimated the age of the Falls as 35,000 years. According to Prof. Spencer, the evolution of the Falls was as follows: A little stream draining the Erie basin only fell about 200 feet over the brow of the Niagara escarpment, and in magnitude was just about the size of the American Falls. This stream was not over one-fourth the present volume of the great cataract, and, consequently, was able to excavate the gorge at a much lower rate than at present. During this early history of the river the waters of the three upper lakes emptied through the Huron basin by way of the Ottawa River. The height of the Falls has advanced several times, and, owing to this change and the variation in the discharge of the water, retreat of the Falls has varied greatly during changing episodes. The computations of the age have been based upon these changing conditions of elevation and downfall of the river. The first episode, as before stated, represented a small river, with a total fall of 200 feet. This lasted about 11,000 years. Then fell another episode, where the height of the Falls was increased from 200 to 400 feet, succeeded by the entire drainage of all the upper Great Lakes. At the same time there were series of three cascades, the lower gaining on the upper, until finally they were all united in one great cataract, much higher than that of the present time. Subsequently the waters were raised at the head of Lake Ontario so as to bring about the present conditions after a lapse of 17,000 years from the end of the first episode. The last or modern episode has lasted 3000 years under nearly the present conditions. Thus we see that the age of the Falls is about 31,000 years, with another 1000 years added for an earlier condition not given. It is now 8000 years since Lake Huron emptied into Lake Erie for the first time. The land has risen about the outlet of Lake Erie, and if the present rate continues, in 5000 or 6000 years the waters of the four upper lakes will be turned into the Mississippi River drainage at Chicago.

Zoology and Botany.

Among the papers read before the section of Zoology were the question of spider bites, L. O. Howard; the pulmonary structures of the Ophidia, Edward D. Cope; photographing fishes and other aquatic animals under water by means of a vertical camera, Simon H. Gage; a migration of cockroaches, L. O. Howard; sexual characters in Scolytidæ, A. D. Hopkins; notes on the genus *Perigoninus*, Sars, Charles W. Hargett; the transformations of the lake and of the sea lamprey, S. H. Gage; on the above-ground buildings of the seventeenth year Cicada, J. A. Lintner.

Prof. L. O. Howard described an extraordinary migration of Croton bugs or German cockroaches, witnessed by him on the streets of Washington on a very dark day last summer. He found that the migrating army, which was composed of many thousands of individuals, consisted almost entirely of females carrying egg-sacs.

At a joint meeting of the sections of Botany and Zoology, Dr. Manly Miles read a paper on the limits of biological experiments. Among other things the speaker pointed out the futility of most feeding experiments. During the discussion which followed, Prof. Edward Cope remarked: "If Weissmann

had been a better botanist he would never have promulgated his theory of the isolation of the germ plasm."

Prof. L. H. Bailey discussed the relation of the age of type to variability. He called attention to the wide range in variability of cultivated types, some of which, he said, vary so much and so quickly that specific types may be lost, yet the difference was not due to age or period, nor to geography or diversity of cultivation. Continuing, he said:

"Variability under cultivation must be ascribed to some original elasticity of the species, and this elasticity or flexibility is no doubt intimately associated with the phylogeny of the type. The common notion that man can modify any plant in given directions is not true. The newer the type the more readily does it vary. All this establishes an intimate relationship between development under cultivation and evolution under natural conditions. They are not two, but one, and the agriculture (*sic*) of man is but an extension of the agriculture of nature."

Prof. Bailey also read a paper on the struggle for existence under cultivation, and during the course of his remarks he said—

"It is commonly supposed that struggle for existence ceases under cultivation, and that man's endeavours and nature's are two. Here we have statistics. There are enough seeds in the United States to stock the world. It is observed that in cultivation there is less waste than in nature. Struggle is more intense than in nature. Not more than one in twenty or more which actually germinate are allowed to mature. But it is a struggle of few against few, rather than a struggle of few against many. This struggle, therefore, instead of fixing the specific type in a warfare against outsiders, sets up a divergence among individuals of the species itself. This, to my mind, is one of the reasons for the rapid development of garden plants."

Other papers read before the joint meeting were:—The numerical intensity of faunas, L. P. Gratacap; the growth of radishes as affected by the size and weight of the seed, B. T. Galloway; the work of the Indiana Biological Survey, A. W. Butler; the movement of gases in rhizomes, Katherine E. Golden; some interesting conditions in wood resulting from the attacks of insects and woodpeckers, A. D. Hopkins.

A paper on evidence as to the former existence of large trees on Nantucket Island, by Dr. Burt G. Wilder, was read before the section of Botany.

Dr. Byron D. Halstead, in a paper upon a root rot of beets, before the section of Botany, described a new disease of those plants.

Major J. Hotchkiss showed specimens of wood cut from trees that had been marked by surveyors 107 years ago. The presence of the injury was still manifest upon the surface of the trees. The growth per year was about one-twentieth of an inch.

Dr. E. F. Smith read a paper on watermelon disease in the south. Other papers read were:—The sugar maples of Central Michigan, W. J. Beal; some affinities among Cactaceæ, John M. Coulter; simplification and degeneration, Charles E. Bessey; regulatory growth of mechanical tissue, Frederick C. Newcombe; further studies in the relationship and arrangement of the flowering plants, Charles E. Bessey.

Anthropology.

Dr. Franz Boaz's address to this section was on human faculty as determined by race. He traced the history of civilisation from its dawn in the far East until now, showing how ideas and inventions were carried from one nation to another. He referred to the civilisations in ancient Peru and Central America, and showed that the general advancement was the same as in Asia and Europe. The only difference was one of time. One reached a certain stage 3000 or 4000 years earlier than the other. But this difference was insignificant compared with the age of the human race. Man had existed for a period to be measured by geological standards only. He showed that, in the past, nations brought into contact with civilisation easily assimilated it, and now they dwindled away before its approach. This was due to the fact that formerly races did not differ so widely as at present, and now disease devastated regions newly opened to white people. The conditions for assimilation in ancient Europe were much more favourable than in countries where primitive people now came in contact with civilisation. This conclusion was confirmed by other facts from the history of civilisation—Northern Africa and in China.

Dr. Boaz remarked: "Several races have developed a civilisation of a similar type to the one from which our own had its origin. A number of favourable conditions facilitated the rapid spread of this civilisation in Europe. Among these common physical appearances, contiguity of habitat and moderate differences in the modes of manufacture were the most potent. When, later on, civilisation began to spread over other continents the races with which the modern civilisation came into contact were not equally favourably situated. In short, historical factors appear to have been much more potent in leading races to civilisation than their faculty, and it follows that achievements of races do not warrant us to assume that one race is more highly gifted than another."

He also said: "After going over the field of anatomical differences, between races, so far as they have a bearing upon our question, our conclusion is that there are differences between the physical characters of races which make it probable that there may be differences of faculty. No unquestionable fact, however, has been found yet which would prove beyond a doubt that it will be impossible for certain races to attain a higher civilisation."

Dr. Boaz expressed the opinion that the probable effect of civilisation upon an evolution of human faculty has been much over-estimated. The psychical changes which are the immediate consequence of civilisation may be considerable. They are changes due to the influence of environment. It is doubtful, however, if any progressive changes or such as are transmitted by heredity have taken place. The number of generations subjected to this influence seems altogether too small. Besides, the tendency of human multiplication is such that the most highly cultured families tend to disappear, while others, who have been less subjected to the influences regulating the life of the most cultured classes, take their place. Therefore, it is much less likely that advance is hereditary than that it is transmitted by means of education.

In conclusion Dr. Boaz said: "The average faculty of the white race is found to the same degree in a large proportion of individuals of all other races, and although it is probable that some of these races may not produce as large a proportion of great men as our own race, there is no reason to suppose that they are unable to reach the level of civilisation represented by the bulk of our own people."

In the Anthropological Section, Dr. Daniel G. Brinton read a paper entitled "Variations in the human skeleton and their causes." The speaker called attention to a number of peculiarities in the human skeleton which had attracted the notice of anatomists, and which had frequently been interpreted as signs of reversion to an ape-like ancestry. He said that most of these variations can be explained by mechanical function, or excess or deficiency of nutrition; and when they can be so explained, this is the only interpretation they should receive. They could no longer be offered as evidence of the theory of evolution, nor considered as criteria or marks of the human races.

Mr. M. H. Saville read a paper on a comparative study of the Glyphs of Copan and Quirigua, in which he presented his conclusions on the hieroglyph "pax." In the discussion of Mr. Saville's paper, Dr. Brinton presented his conclusions, which he announced for the first time, based upon studies of vases in the museum of Pennsylvania, that the symbol pax was a representation of the sacred drum of the Aztecs, and that the hieroglyph stood in the codices for paxahs, "It is finished."

"Iroquois migration" was the subject of a brief paper by the Rev. Dr. Beauchamp, who said that one at least of the three great divisions of the Iroquois family had its centre near the south-western border of Lake Erie.

Mr. Frank Hamilton Cushing, ethnologist for the Bureau of American Ethnology at Washington, read a paper entitled "Salt in Savagery." He referred tot he universal liking for salt among the Indians of North America. The Zuni Indians believed that the first salt came from the sun. According to Indian mythology, there is a salt goddess who is the daughter of the ocean. Mr. Cushing related her genealogy, and then proceeded to discuss the influence of salt upon the culture of the Indians in the south-west. He stated that he believed that nothing led the cliff-dwellers down from their inaccessible dwellings to live in villages more than their desire for salt. Men's dispersion over the world, said Mr. Cushing, is largely influenced by salt. Coming down from his arboreal retreat, where he lived on nuts and fruit, he found the seashore and acquired a taste for a substance now universally used.

Mr. R. G. Haliburton read a paper on the dwarf races of the New World.

Rev. W. H. Beauchamp described the southern visit of the Eskimo, in which he declared that evidence of Eskimo contact with the Indians of Northern New York were to be found in certain stone knives found among them, specimens of which he exhibited.

Mr. Dorsey read a paper by William Sturtevant, in which Mr. Sturtevant described three ears of corn from prehistoric graves from localities in Peru, collected by Mr. Dorsey, the especial point of interest being that from a grave of undoubted antiquity in Iquique was found a kind of corn which was commonly supposed to be of a recent cultivated variety. Mr. Dorsey called attention to the great importance of collecting and preserving all varieties of corn from all prehistoric sources as a means of determining the original habitat of the maize, as well as furnishing an index of civilisation.

THE DISPLACEMENTS OF THE ROTATIONAL AXIS OF THE EARTH.[1]

DISPLACEMENTS of the rotational axis of the earth with reference to fixed directions in space have been observed since the earliest ages of astronomical measurement; for such displacements, visible in wanderings of the pole of the apparent diurnal rotation of the celestial sphere among the constellations of fixed stars, exist in such enormous amplitudes, that in their main features they could be detected by the aid of very simple apparatus and observations.

The true law and explanation of these wanderings of the pole remained, nevertheless, a deep mystery till Copernicus lifted the veil by showing that they were only the celestial image of real displacements of the rotational axis of the earth in space, and until Newton came and, combining his discovery of universal gravitation with his deduction of the ellipsoidal figure of the earth, proved that these displacements are due to the actions of the moon and the sun on the earth.

The mathematicians of the eighteenth century completed this explanation by profound researches embracing the full theory of free rotation of a solid system of masses, under the action of various disturbing influences, not only those acting from outwards on the rotating body (as in the case of the sun's and the moon's attractions on the earth), but also those depending upon the condition or changes within the rotating system itself.

Among several interesting results, these investigations pointed out an essential difference between the development of the disturbed rotation in the first and in the second case.

Upon the supposition, corresponding to the real terrestrial conditions of the problem, namely, that all the disturbing influences are relatively small in comparison with the amount of energy represented by the primary rotation of the earth itself, the following distinctions were demonstrated.

Exterior disturbing influences will mainly produce displacements of the axis in space, and corresponding wanderings of the pole among the stars, whilst the simultaneous displacements of the axis in the earth itself, in consequence of the particular conditions of their evolution, remain insensible.

On the contrary, interior conditions and disturbing influences, as those contained in the configurations of the masses, or in changes of the distribution of the masses composing the rotating system, will mainly produce displacements of the rotational axis in the rotating body itself, whilst in this case the simultaneous displacements of this axis in space and the corresponding variations of the position of the pole among the stars remain insensible.

Very soon after these deductions had been made from the theory, astronomers began to inquire if also effects of the latter type, that is to say, displacements of the rotational axis in the earth, really existed.

According to the theory, such displacements ought even then to exist when the distribution of the masses composing the earth is not in the slightest degree variable.

It is sufficient for producing such displacements that the position of the rotational axis of the earth is actually not in perfect coincidence with one of its principal axes of inertia, known as the principal axis.

[1] A paper read by Prof. W. Foerster, Director of the Royal Observatory of Berlin, before the British Association.

The slightest deviation of the rotational axis from the principal axis has the consequence that the pole of the rotational axis begins and continues to describe a small circle around the pole of the principal axis.

The velocity of this movement depends upon the law of the figure and of the distribution of the masses composing the earth, and the best numerical data for this dependence had given the result that the displacement in question would probably have a period of nearly ten months.

Now all such displacements, possibly measurable with reference to fixed directions in the earth, and insensible with reference to fixed directions in space, could be found in the most favourable way by measuring as exactly and continuously as possible the distance of the pole from the zenith of the observer's station; in other words, by repeated determinations of the geographical latitudes. But, notwithstanding very long and refined determinations of the geographical latitudes at some of the principal observatories, beginning shortly before the middle of the present century, only very uncertain and discordant traces of the phenomena in question were found.

The reason for this want of success is now very clear. Astronomers had limited their researches too narrowly to the last-mentioned type, namely, to the supposed regular ten-monthly periodical movement of the pole of the rotational axis around the pole of the principal axis. Too easily it had been admitted that all the existing variations of the distribution of terrestrial masses were by far too small for altering sensibly the position of this principal axis itself.

It was Lord Kelvin, at the Glasgow meeting of the British Association (1874), who at first drew the attention of the scientific world to the consideration of the great natural transports of masses of air and water and various masses by the water, going on continuously and periodically in the form of currents and circulations of different kind, as well in the atmosphere as in oceans and rivers, for instance the enormous periodical sediments of snow and ice. He showed that these very considerable variations of the distribution of masses on the earth could not only produce sensible displacements of the principal axis of inertia, but that such displacements of this axis could have an amplifying effect on the total amount of displacements of the rotational axis.

For if the principal axis were itself not in a constant position, the theoretically required movement of the rotational axis around the principal axis would become a very complicated movement, differing entirely from the simple form which to that epoch had appeared in the researches of astronomers.

This epicyclic character of the movement of the pole of the rotational axis could considerably modify not only the length of the period, but also the whole geometrical character and amplitude of the curve in such a way, that in longer periods epochs of very small variations of latitude could alternate with epochs of considerably increased variations of latitudes. Possibly, as a further consequence of this complication of the displacements of the two axes, and as a consequence of the still existing plastic state of certain parts of the earth, as well as by the damping effects of the fluid parts, even *progressive*—though very slow and unsteady progressive—displacements of the rotational axis in the earth could still result.

The field of this research was thus decisively cleared by the veritably releasing ideas of Lord Kelvin. Finally, about four years ago, by the co-operation of some observatories with the International Geodetic Union, clear evidence was obtained, and in the last three years, with the aid of an expedition sent by the International Union to Honolulu, decisive proofs of such displacements have been found. I consider it a special honour and pleasure to be enabled to submit some of the newest results of this international co-operation to a meeting of the same Association which, twenty years ago, had been witness of the almost prophetic assertions of one of its most illustrious members regarding the real conditions of this important phenomenon.

I have prepared a diagram (Fig. 1, p. 489) showing these newest results. You see in this diagram a representation of the wanderings of the pole of the rotational axis of the earth on the surface of the latter during the last twenty months, from October 1892 to May 1894.

This sketch is founded on nearly 6000 single determinations of latitude made in the Observatory of Kasan (Eastern Russia), Strassburg (Elsass), and Bethlehem (Pennsylvania). The observations are condensed in twenty monthly mean results,

numbered, as you see, from zero to nineteen. Every one of these resulting monthly positions of the pole indicated by the centres of the small circles is thus the mean result of about 300 single determinations.

The accompanying figure is drawn on a scale of two millimetres to one-hundredth of a second of arc, and the maximum amplitude of the curve is nearly 50-hundredths, or half a second. The amplitude of these movements of the pole on the surface of the earth is between 40 and 50 feet.

You see the general character of the movement quite in accordance with what has been mentioned concerning its complicated and somewhat spiral character. The sense of the motion is turning from west to east. The velocity is apparently very variable, and it seems as if we now approach an epoch in which the amplitude considerably diminishes. It is also evident that such

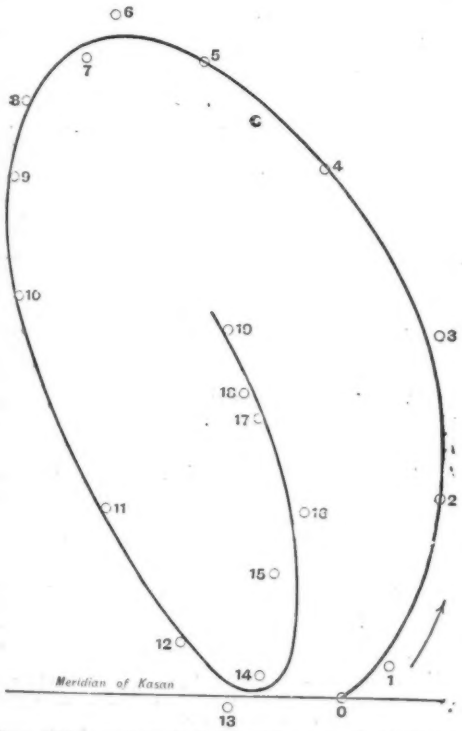


FIG. 1.—Movement of the North Pole of the rotational axis of the earth Derived from observations made at Bethlehem, Strassburg, and Kasan :—

0 = 1892 Oct 20	13 = 1893 Nov. 1.
1 = ,, Nov, 1.	14 = ,, Dec. 1.
2 = ,, Dec. 1.	15 = 1894 Jan. 1.
3 = 1893 Jan. 1.	. . . . .
. . . . .	. . . . .
. . . . .	19 = 1894 Mar. 30.

a character of movement can very easily produce slow progressive motions, and also from this reason the whole phenomenon wants to be watched incessantly and very carefully.

The astronomers and geodetists who are now associated in the International Geodetic Union, have invited the geologists to associate with them in this common research. Such an international organisation will be also useful and almost indispensable for a great part of the work of astronomical observatories.

It is to be hoped that Great Britain will now participate in this international union, embracing all other civilised nations. Such organisations, with their clear and reasonably limited aims, involve not only real economies and refinements of mental work, combined with diminutions of material expenses, but it is hoped that they will also have a great importance as slowly growing foundations of human and terrestrial solidarity.

SCIENCE IN THE MAGAZINES.

MR. HIRAM S. MAXIM gives, in the *National*, a brief description of his experiments on flying by means of aeroplanes. His flying machine, when finished and loaded with its water, its fuel, and three men, weighed very nearly 8000 lb., and the actual horse-power developed on the screws was 363 horse-power, with a screw-thrust of rather more than 2000 lb. The total width of the machine was over 200 feet. It was found that upon running the machine at thirty miles an hour very little load remained on the lower track, and at thirty-six miles an hour the whole machine was completely lifted.

The *Fortnightly* is remarkable this month for two critical articles by Prof. Karl Pearson and Mrs. Lynn Linton, respectively. Prof. Pearson assails Lord Salisbury's address to the British Association, and moans over the fact that Lord Kelvin courteously said that throughout it "there was the spirit of the student, the spirit of the man of science." Here is his opinion on it: "We find nothing in it which shows the spirit either of student or of man of science; it teems with fallacious conclusions, and whatever may have been intended by the author, it can only serve as an appeal to that gallery which is occupied by the reconstructed theological party." Mrs. Lynn Linton outpours the vials of her wrath upon Prof. Henry Drummond and his "Ascent of Man." "He brings his subject," says she, "which only the educated can rightly understand, down to the level of the ignorant. He strips science of her divinity, and sends her out as a cottage-maid, or rather as a young priest, of whom no one need be afraid. But he lets slip truth in this endeavour to extract milk for babes out of the meat for men; and his rendering of synthethic philosophy is both inadequate and shallow. Whatever is true is borrowed; whatever is false, strained, and inconclusive, is his own. His sin is the sin of plagiarism, with the additional offence of distortion in the lifting." Surely a writer never received a more terrible flagellation than this.

Brief descriptions will suffice for other articles of more or less scientific interest in the magazines received by us. Sir Robert Ball contributes to *Good Words* a paper on Galileo. The *Century* contains a continuation of Messrs. Allen and Sachtleben's account of their journey across Asia on bicycles; and a fine picture of an aurora, observed and sketched at Godthair on September 3, 1892, by Mr. F. W. Stokes, one of the members of the Peary Relief Expedition. Dr. Carl Lumholtz describes in *Scribner* the life and costumes of the Tarahumaris, the inhabitants of the Sierra Madre. In *Chambers's Journal* we find a diversity of instructive articles. Among the subjects scientifically treated are "British Ring-Snakes," "Dynamite," "Sweet Lavender," and "Sources of Power in Nature." Lovers of nature will find pleasure in an article entitled "In a Rock Pool," contributed by the Rev. Theodore Wood to the *Sunday Magazine*, and geographers will be interested in a description of the inhabitants of the Andaman Islands. Under the title "Spirit and Matter," Emma Marie Caillard philosophises, in the *Contemporary*, on such psychical subjects as were touched upon by Prof. Oliver Lodge in his British Association address in 1891.

SCIENTIFIC SERIALS.

Bulletin de l'Académie Royale de Belgique, No. 7.—Comparative study of the isothermals observed by M. Amagat and the isothermals calculated from M. Van der Waals's formula, by MM. P. de Heen and F. V. Dwelshauvers-Dery. A comparison of the theoretical and experimental isothermals shows that the molecules which constitute carbonic anhydride expand regularly as the temperature increases. The coefficient of mean molecular expansion, for temperatures between 30° and 258°, is sensibly equal to 0·001, a number which closely approaches the coefficient of expansion of liquids in general. To this intramolecular dilatation corresponds the internal latent heat of dissociation, made evident by the variability of the specific heat of carbonic anhydride in the gaseous state. Since Van der Waals's equation furnishes fairly accurate values for the part o the isothermals situated to the right of the minimum, one might feel tempted to introduce another constant and to force the curve to pass through a supplementary point conveniently chosen to the left of that minimum. This would give much more satisfactory results, but they would have no value with

regard to the theory.—On the motion of the satellites of the planets with respect to the sun, by P. Stroobant. The author points out that the moon alone, among all the satellites, always turns the concavity of its orbit towards the sun. This concavity is less at new than at full moon, but the attraction of the sun always outweighs that exerted by the earth. The author investigates theoretically the motions of the satellites round the sun, and introduces the attractions of their planets as perturbations. In order that the trajectory may be looped, the linear velocity of the satellite must be superior to that of the planet. The satellites I., II. and the new one of Jupiter, and Mimas, Enceladus, Tethys, and Dione of Saturn are the only satellites with looped orbits. The rest of the satellites follow a sinuous curve with points of inflexion. Those of Uranus are not taken into consideration. The author expects that if the moon is considered as revolving round the sun, subject to perturbations due to the earth, the lunar theory will be simplified, and successive approximations will be more convergent.

Bulletins de la Société d'Anthropologie de Paris, tome v. (4e serie), No. 3, March 1894; No. 4, April 1894.—Meeting of February 1, 1894.—Dr. P. Mauclaire and M. Bois contributed a note on Ectrodactyly and Syndactyly, in which they describe a very remarkable case, where the right foot and both hands have the appearance of a two-pronged fork. The authors had the opportunity of dissecting this subject, and give a most interesting account of the anatomy.—M. Paul Denjoy described a religious ceremony in Annam, celebrated at the commencement of the new year in honour of ancestors.—M. Ch. Letourneau read a paper on synthetic literature of the first ages, and M. F. Gaillard contributed a note on the sculptures of Gavr Inis.—On February 15, M. E. d'Acy made a communication on flint implements from the plateaus of Picardy and Normandy.—At the meeting of March 1, M. L. Lapicque exhibited some photographs of the inhabitants of the Mergui Islands (the Selungs), and made some anthropological and ethnographical observations on those people. The Mergui archipelago is situated off the coast of Tennasserim (long. 96° 20′ E.; lat. 13° to 9° N.). It is composed of lofty islands covered with ancient forests. The islands themselves may be said to be uninhabited, but in the straits and roadsteads of the Archipelago are to be found several tribes of nomadic fishermen who live entirely on their boats, except during the wet season, from May to September, when they come ashore and build temporary habitations for themselves on the coast. They are very wild, and hold little communication with the people on the mainland. The people seem to be of Malay origin, but there is evidently a considerable admixture of foreign blood of various kinds.—On March 15, M. G. Lagneau read a paper on the mortality from tuberculosis as affected by occupation and by residence.—M. O. Lambert offered some observations with regard to a recently observed case of the presternal muscle, in which he contended that the names *rectus thoracis* and *sternalis brutorum* as applied to this muscle are misleading, and that it ought to be regarded as a survival of a connection that once existed between the panniculi of the abdomen and of the neck.—Dr. Michaut contributed an account of the prehensile foot among the Japanese and Annamites.—M. A. Ponchon gave an account of the caves of Herleville, Canton of Chaulnes (Somme); and M. Octave Vauvillé read a paper on the enclosures, dwellings, and common pottery of the Gallic epoch. The conclusions at which M. Vauvillé arrives are (1) that the same forms of pottery were in use at the same time in different parts of the country; (2) that the pottery, at the close of the Gallic epoch, was generally made with a wheel; and (3) that it is evident that true artists existed amongst the potters of that period.

L'Anthropologie, tome v. No. 3, May–June 1894.—In an article on the inauguration of anthropology and human anatomy at the Jardin des Plantes, M. E.-T. Hamy gives a most interesting account of the work of Marin Cureau de la Chambre and Pierre Dionis, who lectured there during the years 1635–1680. Dr. R. Collignon contributes an anthropological study of the Basque race, in the form of a summary of a work published *in extenso* in the "Memoirs of the Anthropological Society of Paris." M. Salomon Reinach continues his exposition of sculpture in Europe anterior to Greco-Roman influences.

Tome v. No. 4, July–August, 1894.—This number opens with an interesting article, by Antony Jully, on funeral rites, graves, and honours paid to the dead in Madagascar. The worship of the dead is greatly developed in the different tribes that people the isle of Madagascar, and the ceremonies connected with it and the monuments that result from it are distinctive characters of that race, composed though it is in all probability of heterogeneous elements. The dead is honoured, not because his memory is dear to his relations, but because they fear to rouse his anger by neglect, and so to suffer from his vengeance. Careful attention is paid to the orientation of the graves, which are placed to the north-east of the house and in close proximity to it.—In a short paper on the remains of Elk and Lion, found in a prehistoric station at Saint Martory (Haute-Garonne), the author explains the reasons that have induced him to include these animals, together with the reindeer, in his list.—In an article on Mycenean Crete, M. Salomon Reinach gives an account of the important discoveries lately made in that island by Mr. Arthur Evans.—M. Eugène Toulouze describes the discovery of an interment of the neolithic period at the village of Saint Mammès (Seine et Marne). The sepulchral chamber measures 1·75m. in length by 0·90m. in width, and it is bounded by walls constructed of comparatively small stones. A vase, a polished axe, an arrow-head, and three other worked flints were found associated with the human remains, which were much damaged.—Prehistoric crania of Patagonia form the subject of a valuable article by Dr. R. Verneau. According to M. Moreno, it is possible to distinguish five or six distinct types amongst the known skulls of the ancient inhabitants of Patagonia. Dr. Verneau shows that all the crania have certain characters in common, such as great capacity, prominent glabella and superciliary ridges, sub-nasal prognathism, extroversion of the mandibular angles, large chin, and much-worn teeth.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"On Some Phenomena in Vacuum-tubes." By Sir David Salomons, Bart.

This paper deals with the phenomenon known as striæ, or bands, in vacuum tubes.

As far as the author could learn from the sources of information available to him, no one had previously discovered how to produce a predetermined number of bright and dark bands in a tube having an open or free path.

After a prolonged investigation he has succeeded in producing this result, and in the present paper he describes, first, the methods by which a definite number of bright and dark bands can be produced in a vacuum-tube; and, secondly, a number of interesting phenomena which have a bearing on the production of the bands in general.

Some of the conclusions drawn from the experiments are:—

That bands may be produced with greater facility in small tubes than in large, and that they become more accentuated probably on account of the inequality of the diameter of such tubes.

That for the production of bands, the glass of the tube itself appears to play a part, since the bands are difficult to produce unless they reach to the glass of the tube.

That an exceedingly minute current produces bands which to the eye, in most instances, disappear when the current is somewhat increased, and on further increasing the current they become visible again. The author believes that in all previous investigations it has been stated that the bands cannot be produced until a considerable current is passed. He refers to investigations by Messrs. Warren de la Rue, Gassiot, and others. His experiments, however, prove the contrary. The probable reason why these statements were made is due to the fact that with the apparatus employed at that time such small currents could not be easily produced. When the minute current is increased, and the bands seem to disappear, the author thinks this is due to an optical illusion; the bands are there, but too faint to be seen, perhaps in consequence of the dark bands being so narrow that they escape observation.

That, when an electric discharge takes place in a large tube in which is placed a partition pierced with a hole, "a forcing effect" frequently appears to be produced. Any bright bands being produced at the hole in the partition may give the appearance of being pushed through to the side of the tube which has the greater length. This phenomenon is mentioned because it is apt to mask many effects, unless the current is suitably adjusted.

That it is not impossible, after the first trace of light becomes visible in a tube when passing a very minute current, that the

dark bands subsequent to this stage are illusory, and that they are really the bright bands; and what appear to be the bright bands consist of overlaps which produce double the brightness of the so-called dark bands. In reality, therefore, the bright bands indicate the position of the dark bands.

That by devices bands can be produced in a large tube occupying only a small portion of the cross sectional area, at any rate so far as the eye can discern.

That, when employing Prof. Crookes' tubes for illustrating experiments on radiant matter, if suitable conditions are observed, striæ are formed in these tubes.

That, in tubes having exceedingly small electrodes, and apparently not capable of producing striæ, these can be shown to exist if very minute currents are employed.

That the tube, when made to act as a condenser, permits more current to pass.

That from the above considerations it is not unlikely that a view, which has been held, in regard to the probable origin of the bands, that they consist of a series of discharges through the tube, is true; that the nature of such discharge can be varied by suitable devices placed within the tubes, and that the examination of the nature of the discharge can be best made with very minute currents, that is to say, currents so small that, if made any less, the tube would no longer show any sign of light.

"The Asymmetrical Probability-Curve." By Dr. F. Y. Edgeworth.

"On the Absorption Spectra of Dilute Solutions." By Thos. Ewan.

In order to measure the extinction coefficients of very dilute solutions, a new spectro-photometer was devised, in which a Lummer and Brodhun photometric prism was used, and the photometric measurements made by means of Abney's rotating sector.

The absorption spectra of dilute solutions of cupric sulphate, chloride, bromide, and nitrate were found to be identical. Solutions of cupric acetate absorb, for the same amount of copper, more light than those of the other salts used. The difference tends to disappear as the solutions become more dilute, and it is increased by the addition of acetic acid.

Measurements of the absorption spectra of a series of solutions of dinitrophenol in pure water were made, from which the amounts of the substance dissociated into ions were calculated, and found to be in very satisfactory agreement with those calculated from the electrical conductivity of the solutions.

The ferric hydroxide formed by the hydrolysis of ferric chloride in aqueous solutions containing less than 0·005 gramme molecules of $Fe Cl_3$ per litre, was found to contain no chlorine. The hydrolysis may therefore be represented most simply by the equation $FeCl_3 + 3H_2O \rightleftarrows Fe(OH)_3 + 3HCl$. The determinations of the quantity of colloid ferric hydroxide contained in these solutions (made partly by the spectro-photometer, partly by filtration through porous earthenware) showed that the equilibrium does not take place in accordance with the law of Guldberg and Waage, but agrees much better with the modified form of the law due to Arrhenius, in which account is taken of the electrolytic dissociation of the different substances.

PARIS.

Academy of Sciences, September 3.—M. Lœwy in the chair.—The marine laboratory of the museum at Tatihou I., near Saint-Vaast-la-Hougue (Manche), by M. Edmond Perrier. A description is given of the laboratory fittings and arrangements, and the work enabled to be done by its means.—On two methods for the study of currents in open circuits and of displacement currents in dielectrics and electrolytes. An abstract of a memoir given by the author, M. de Nicolaïeff. Discs or rings of dielectrics are, in the first method, supported by bifilar suspension between the two poles of an electromagnet so that the plane of the ring is at 45° to the axis of the electromagnet, and centrally situated between the poles. The difference in the displacements caused in constant and alternating fields of the same strength is due to a secondary field set up by displacement currents caused in alternating fields. Paraffin shows an augmentation of 12 per cent. for a period of 930 per minute, and 9 per cent. for 770 per minute. In the second method, displacement currents in the rings are caused by the iron in the magnet cores. The ring is suspended perpendicular to the axis of the cores; the polar faces are able to be brought nearer to or removed farther from the parallel faces of the ring. By this method, augmentations have been obtained of 15 per cent. for yellow wax, and 8·3 per cent. for paraffin. Electrolytes in annular glass tubes behave just like perfect dielectrics, sulphuric acid giving an augmentation of deviation of 15 per cent.—Assimilability of potash by the action of nitrates in poor siliceous soils, by M. P. Pichard. It is shown that, in presence of nitrates, a part of the potash combined with silica is capable of being assimilated by various plants, and hence that it is necessary to determine the total potash present in soils as well as that portion eliminated by acids or aqua regia when estimating the agricultural value of soils.—On the construction of the circle derived from seven right lines or defined by the equation $O = \Sigma_1^7 l_1 T_1^3 \equiv X^2 + Y^2 - R^2$, by M. Paul Serret.—On a new gravimetric method for the estimation of glucose, by M. Fernand Gaud. Cuprous oxide is obtained in much the usual manner by reduction, but care is used to carry out the reduction below 100° by using a water-bath as source of heat. The reduced suboxide is then weighed by transferring the carefully-washed precipitate to a specific gravity bottle, and filling up with boiled water and weighing. The weight p of the precipitate is given by the formula

$$p = \frac{P - V_t d}{1 - \frac{d}{\Delta}},$$

where P is the weight of the water and precipitate, V_t is the volume of the flask at the temperature of experiment t, d is the specific gravity of water at the same temperature, and Δ is the specific gravity of dry cuprous oxide 5·881. The quantities of glucose corresponding to given amounts of cuprous oxide are as follows:—10 mg. of $Cu_2O = 5·413$ mg. of glucose; 20 = 9·761; 30 = 14·197; 50 = 23·036; 100 = 46·221; 200 = 91·047; 300 = 138·842; 400 = 188·928.—Phenomena following from the dialysis of the cells of the beer ferment, by M. E. Onimus. Yeast secretes a dialysable substance which inverts the sugar present before new cells are produced. The medium is modified by the zymase, and then only becomes able to support the production of new cells.—On the Constantinople earthquake of July 10, 1894, by M. D. Eginitis. The method of Dutton and Hayden gives the focus at a depth of 34 km. The speed with which the shock travelled to various places is as follows:—Paris, 3 km.; Pavlovsk, 3·5 km.; and Bucharest, 3·6 km. per second.

BERLIN.

Physiological Society, July 6.—Prof. Munk, President, in the chair.—Dr. J. Munk had tested the results of his experiments on fasting man by further new experiments on dogs, with the special object of investigating the excretion of chlorine, phosphorus, lime and magnesia, which he had found to be increased in man during hunger. During ten days of fasting he found all four of the above substances, but especially phosphorus and lime, in largely increased quantities in the urine, as compared with days of normal dieting. The fæces also during hunger, which closely resembled meconium both in appearance and composition, contained an increased amount of phosphorus, lime, and magnesia. By calculating, from the amount of nitrogen excreted, the amount of body-proteid metabolised during hunger, he found that only a portion of the excreted phosphorus could have come from the proteid; the remainder must have resulted from the metabolism of some constituent of the body rich in phosphorus and lime. The ratio of these to each other corresponded to a metabolism of bone-substance amounting to about 39 grms. in ten days of hunger. Dr. Munk further reported on experiments on dogs, in which he at one time administered a given amount of meat all at once, and at another time the same amount of meat distributed over three meals. In the latter case the excretion of nitrogen in the urine was greater than in the former, indicating a less perfect utilising of the proteid. This result on dogs is, however, not applicable to man, in whose case the conditions are different, and in whom, as shown by Ranke's older experiments, a given amount of food is more completely utilised if taken in separate portions than if eaten all at once.—Dr. Engel gave an account of his observations on the blood-corpuscles of incubated hens'-eggs, leading to results essentially the same as those obtained from mammalian embryos. In birds the red and white corpuscles and platelets take their origin from nucleated red cells. These views were supported by photographs and microscopic preparations, which were, however, regarded by Dr. Benda as not excluding the possibility that the appearances they presented were purely artificial.

July 20.—Prof. du Bois Reymond, President, in the chair.—Mr. W. T. Porter, of Boston, spoke on spinal respiratory tracts, and gave an account of the following interesting experiments:—On unilateral section of the cord at the level of the nucleus of the phrenic, the movement of the diaphragm on the same side ceases or becomes very weak, whereas it continues unaltered on the other side. If now the phrenic nerve on the uninjured side be cut through, the diaphragm on this side becomes relaxed, while at the same time, on the other side with the unilateral section, the movements of the diaphragm begin again and are continued quite normally. Prof. Koenig had been able, in conjunction with Miss Koettgen, to investigate the absorption of light by visual-purple from a freshly extirpated human eye. A portion of the solution was examined in an unaltered condition, and the remainder after it had been converted into visual-yellow by the action of green light. The curves of the transmission of light for a solution of visual-purple were found to be identical with the luminosity curves of the totally colour-blind, and of bi- and tri-chromatic eyes where the intensity of light is so small that colours cannot be perceived. The curve for a solution of visual-yellow was the same as the luminosity curve of a red-green colour-blind eye. From the above, Prof. Koenig deduced the probability that visual-purple serves for the perception of undefined colourless grey, while visual-yellow serves for the perception of blue. Since both visual-purple and, hence also, visual-yellow are absent from the fovea centralis, this part of the retina should be colour-blind for blue. The speaker brought forward a series of facts in support of this view, and a discussion followed.

July 27.—Prof. du Bois Reymond, President, in the chair.—Prof. Koenig first spoke about an "experimentum crucis" as to his theory of the significance of visual-purple which had been suggested during the discussion at the end of the last meeting, and declared it to be irrelevant. Dr. Greef described the neuroglia cells of the retina and chiasma of the optic nerve as prepared by Golgi's method, and which were called spider-cells, owing to their small elongated bodies and long slender processes. A comparison of these cells in different classes of vertebrate animals had shown that they are most numerous in man, and possess the longest and slenderest processes, while they are less numerous and have shorter and thicker processes the lower one goes in the vertebrate scale. The function of the cells appears to be to isolate the individual nerve-fibres. Prof. Kossel had further investigated the products of the decomposition of nucleic acid, and obtained a much simpler chemical composition for thymin, based on its elementary analysis, than in his previous researches. He had also discovered a new base, which he called "cytosin," and whose reactions he described in detail. Prof. Kossel further described a new and simpler method for determining urea in urine, consisting in a modification of Bunsen's well-known method, and which had proved itself trustworthy as applied to solutions of urea of known composition. Dr. Krüger had isolated a new base of the xanthin group from human urine, which, while it differed materially in its reactions from the xanthin bodies, but showed much resemblance to guanin, he had named epiguanin. Dr. Lilienfeld gave an account of his further researches on diglycocollamide esters. By combining diglycocollamide with leucic acid, as also with tyrosinic and asparaginic acids, he obtained various substances which all gave proteid reactions. One of the compounds so closely resembled ordinary peptone, both in appearance and in all its reactions, that he had provisionally given it the name of synthetised peptone. He reserves for himself the further investigation of this interesting group of synthetic products.

NEW SOUTH WALES.

Linnean Society, July 25.—Prof. David, President, in the chair.—The following papers were read:—(1) Observations on the femoral gland of *Ornithorhynchus* and its secretions, together with an experimental inquiry concerning its toxic action, by C. J. Martin and F. Tidswell. The gland is a compound racemous variety with large alveoli possessing a wide lumen, and somewhat recalling the appearance of a mammary gland. The alveoli communicate with ducts which eventually join at the hilus of the gland to form the duct leading to the spur. The gland is surrounded by a capsule of fibrous tissue, exterior to which is a thin layer of smooth muscle fibres. A marked difference in the minute structure of the gland was noted in animals killed in June and those in April respectively, the former showing the appearance characteristic of an actively secreting gland, whereas the latter suggested that of a mammary gland when it had undergone retrogressive morphosis. Examination of the poison showed it to consist principally of albuminous bodies, and the introduction of these into rabbits produced very marked poisonous results. When injected under the skin, local swelling, and great general depression and rise of temperature followed, but in three days the animal was well again. When the poison was introduced directly into the vascular system, small quantities (⅓ grain) caused death in under half an hour. Larger doses so introduced produced almost immediate death, by producing nearly universal clotting of the blood whilst travelling in the blood-vessels. Such clotting naturally soon put an end to all circulation. In summing up, the authors compared the action of Platypus poison with that of the venom of Australian snakes, supposing the latter to be diluted 5000 times.—Notes on Australian "shipworms," by C. Hedley. A large species of "shipworm" or "cobra" from South Australia, perhaps the largest yet discovered, was described and figured under the title of *Teredo edax*. The type of *T. antarctica*, Hutton, from New Zealand was also figured to demonstrate that the supposed recognition of this species from the coast of Queensland was erroneous.—On five interesting shields from Northern Queensland, by R. Etheridge, jun.—Additional notes on the Palæontology of Queensland. Part i. Palæozoic, by the same.

BOOKS and SERIALS RECEIVED.

BOOKS.—The Works of Hertz and some of his Successors: Prof. O. Lodge (*Electrician* Co., Ltd.).—Glasgow and West of Scotland Technical College Calendar, 1894-95 (Glasgow, Anderson).—Catalogue of the Michigan Mining School, 1892-94; Announcements, 1895-96 (Houghton, Michigan).—Trattato di Materia Medica: Prof. P. Giacosa (Torino, Bocca).—Ponds and Rock Pools: H. Scherren (Religious Tract Society).—Heat treated Experimentally: L. Cumming (Longmans).—Theoretical Mechanics: Solids: A Thornton (Longmans).

SERIALS.—Geological Magazine, September (K. Paul).—Publications of the Astronomical Society of the Pacific, Vol. 6, No. 35 (San Francisco).—American Meteorological Journal, September (Ginn).—Engineering Magazine, September (Tucker).—Tufts College Studies, No 2 (Tufts College, Massachusetts).—Brain, Part 67 (Macmillan).—Medical Magazine, September (Southwood).—Science Progress, September (Scientific Press).—American Journal of Science, September (New Haven).—Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, nouvelle serie iv., Nos. 1 and 2 (St. Petersbourg).

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